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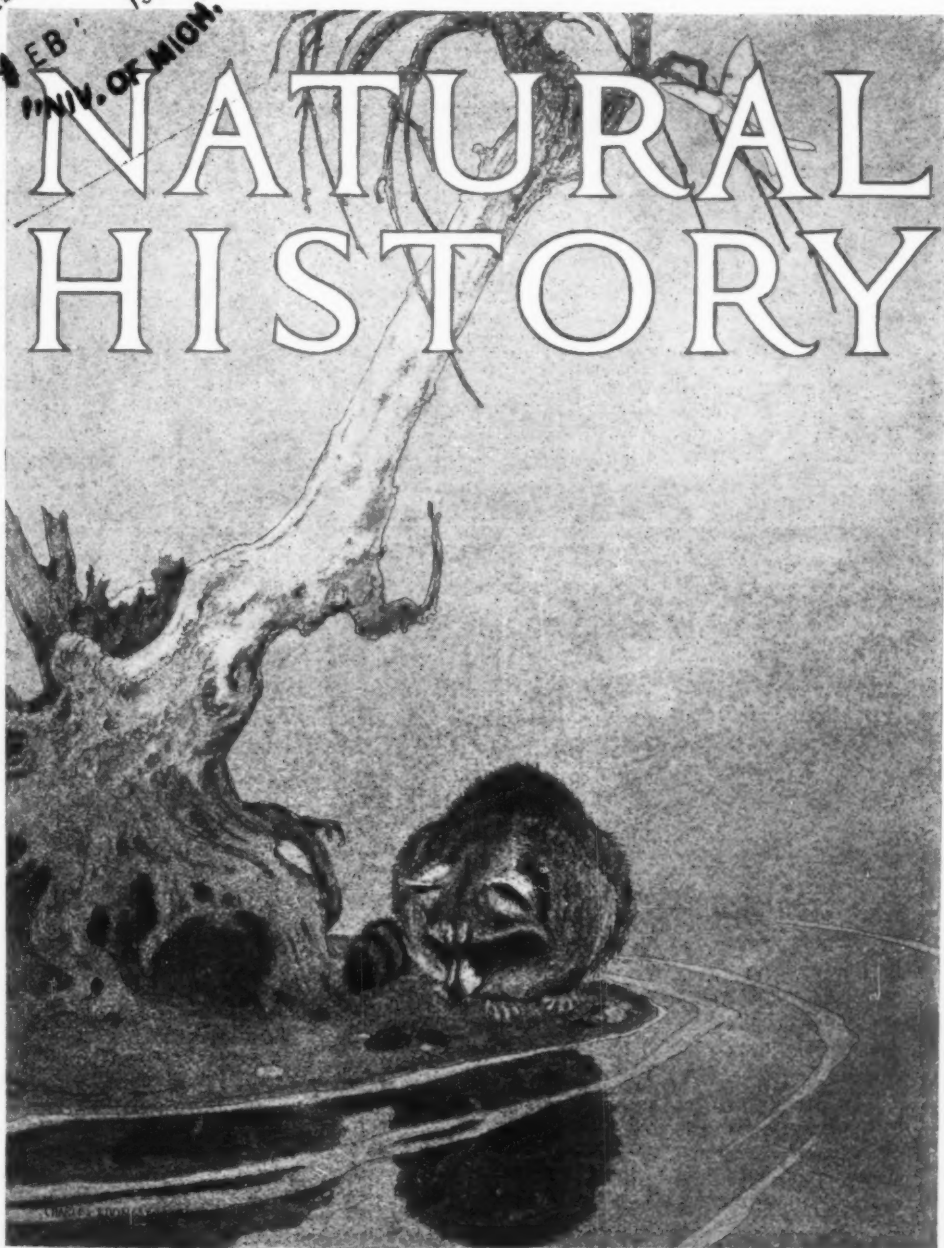
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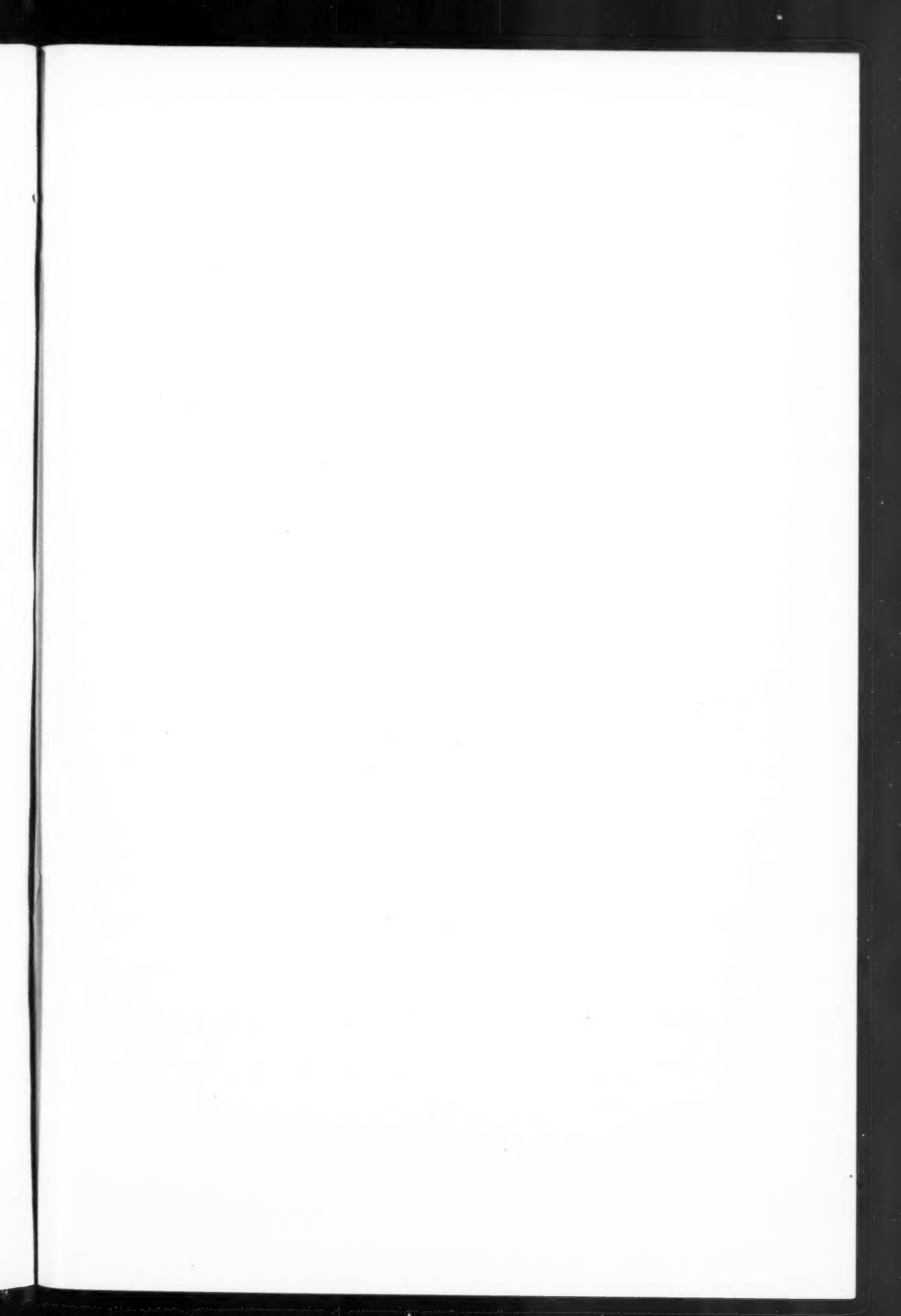
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Portrait of J. Reid Moir, archaeologist of Ipswich, who has discovered in beds of Pliocene age positive evidence of the existence of man with a knowledge of the use of fire and the ability to fashion flints



Portrait of E. Ray Lankester, veteran zoologist surviving from the great Victorian age of British science, who has encouraged the work of Moir and lent his authority to the human origin of the Upper Pliocene flints

NATURAL HISTORY

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THE PLIOCENE MAN OF FOXHALL IN EAST ANGLIA

BY

HENRY FAIRFIELD OSBORN

THE progress of prehistorical studies has been very marked since Professor Osborn's "Palæolithic tour" of 1913, when materials were gathered for *Men of the Old Stone Age*. Consequently, as a vacation tour in the summer of 1921 he planned to visit many of the prehistoric centers in western Europe which were not visited during the tour of 1913: first, East Anglia, the scene of the most remarkable palæontological discovery of recent times, namely, of Pliocene man in Britain; second, the Sussex home of Piltdown man; third, the New Stone Age region of Scandinavia—Norway, Sweden, and Denmark—the home of our ancestors of 12,000 B. C. Thence Professor Osborn traveled across the early Neolithic region of Belgium and France to the Pyrenees to see two newly explored caverns on the estate of the Count de Bégouen; thence to Bordeaux to view the most ancient sculptures of Laussel; thence northward to Brittany to examine the comparatively recent Neolithic and bronze culture of four thousand years ago. The impressions made by this tour will be written down in six successive articles in NATURAL HISTORY beginning with the articles in the present issue.

THE discoveries by J. Reid Moir of evidences of the existence of Pliocene man in East Anglia open a new epoch in archæology in which the southeastern corner of Great Britain is destined to play a very important part. In their bearing on human evolution these discoveries are no less revolutionary, because they bring indubitable evidence of the existence of man in south-east Britain, man of sufficient intelligence to fashion flints and to build a fire, before the close of Pliocene time and before the advent of the First Glaciation, which opens the Pleistocene or Quaternary history of man. That is, we have at last in the Foxhall flints found proofs of the existence of real *Tertiary man*.

Other discoveries, made both before and since that of Foxhall, will form, if fully authenticated, an unbroken chain of evidence. The geologic order of occurrence of these vestiges of man as shown in the geologic table (p. 566) is as follows:

(3) Giant Flints of Cromer, Lower Pleistocene, found in 1920.

(2) Foxhall Flints of Ipswich, Upper Pliocene, found in 1919.

(1) Pre-Crag Detritus of Ipswich, Rostro-carinates, etc., reported in 1909.

THE ALLEGED PRE-CRAG HUMAN INDUSTRY UPPER PLIOCENE

As evidence of the most ancient industry in the so-called "detritus-bed" below the Pliocene Red Crag of Suffolk, there were first found by Moir in 1909 a number of beak-keeled implements called "rostro-carinates" (from *rostrum* = beak and *carina* = keel). These Lankester and Moir believe to represent artifacts of a still earlier stage than either those of Foxhall or of Cromer. Of the men that produced the flints Moir writes:¹

"The pre-Crag people . . . had an abundance of flint of very fine quality, in the form of nodules, with which to work, but the more or less rounded surfaces of nodules did not afford a satisfactory striking-platform, and so they had to learn to provide themselves, by flaking, with a flat surface upon which blows could be struck with precision. . . . The ventral surface of the rostro-carinate formed by the removal of a large flake from the original flint nodule, represents the natural flat surface of tabular flint, and in both cases blows were delivered on each side of this flat surface . . . in the rostro-carinate the keel or gable seems to have been the desired object."

¹Moir, J. Reid, *Pre-Palæolithic Man*, 1920, pp. 1-67, Pls. 1-XXIX.

ADVANCES OF THE GREAT SCANDINAVIAN GLACIERS INTO NORTHERN EUROPE		SUCCESSION OF FLINT INDUSTRIES AND HUMAN RACES	
	<i>Postglacial Time</i>		<i>Aurignacian-Magdalenian Industry, Cro- Magnon Race</i>
QUATERNARY — PLEISTOCENE	IV. FOURTH GLACIAL TIME		<i>Mousterian Industry, Neanderthal Race</i>
	<i>3rd Interglacial Time</i>	}	<i>Acheulean Industry, (1) warm and (2) cold</i>
	III. THIRD GLACIAL TIME		<i>Chellean, warm mammal fauna of northern France and England. The Chellean In- dustry, announced in 1846, is now regarded as beginning (pre-Chellean phase) in 2nd Interglacial Time</i>
	<i>2nd Interglacial Time</i>	}	
	II. SECOND GLACIAL TIME		No trace of human industry thus far dis- covered in France in this very long period of geologic time. The <i>Heidelberg</i> (Ger- many) and <i>Piltdown</i> (England) races and associated primitive industrial flake flints are referred to this period
	<i>1st Interglacial Time</i>	}	
	I. FIRST GLACIAL TIME		(3) Flint Industry of Cromer, Norfolk, England
TERTIARY	UPPER PLIOCENE TIME		(2) Flint Industry of Foxhall, Ipswich, Suffolk, England
			(1) Pre-Crag Industry, Ipswich, Suffolk, England

According to Moir the rostro-carinate of the sub-Red Crag has evolved from two antecedent stages, followed by four succeeding stages in the last of which the rostro-carinate pattern almost disappears. In his valuable treatise on *Pre-Palæolithic Man*, just cited, Moir describes his theory of the early evolution of the flint industry. Moir herein maintains that the Piltdown man—the *Eoanthropus* of Smith Woodward—was of Upper Pliocene age and possibly the maker of the earliest types of flints thus far discovered, namely, those of Foxhall. This opinion will serve to introduce the second article of this series, namely, on the Piltdown man.

THE UNDISPUTED FOXHALL INDUSTRY OF RED CRAG TIME

Proofs which have rested hitherto on the doubtful testimony of irregular eoliths generally considered by archaeologists as not of human manufacture, now

rest on the firm foundation of the Foxhall flints in which human handiwork cannot be challenged; these proofs have convinced the most learned and most conservative expert in flint industry in Europe today, namely, Abbé Henri Breuil of the *Institut de Paléontologie Humaine*.

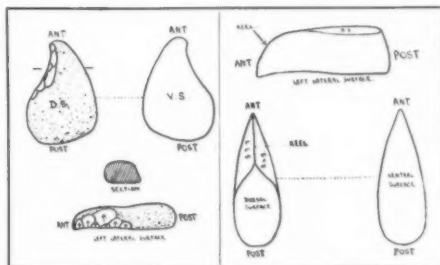
This discovery of man in Pliocene time delights the present writer for a personal reason, namely, because it tends to render somewhat more probable his prophecy made in April, 1921, before the National Academy of Sciences at Washington that one of the great surprises in store for us in science is the future discovery of Pliocene man with a large brain. At present, however, we know nothing of the brain weight and little of the degree of intelligence of the man who fashioned the flints of Foxhall near Ipswich. In this connection may now be narrated another of the remarkable incidents in the prehistory of man, namely, the story of the "human jaw of Foxhall."

The possibility that there may exist a human jaw of the same geologic age as the Foxhall flints has recently been pointed out by the Ipswich archaeologist, J. Reid Moir.¹ He calls attention to a paper, long forgotten and almost lost sight of, which appeared in the *Anthropological Review* of 1867, entitled, "The Fossil Human Jaw from Suffolk," by R. H. Collyer, M.D.,² on page 221 of which occurs the following statement:

"At the instigation of Vice-Admiral Sir Edward Belcher, C.B., I was induced to exhibit to the Ethnological Society of London in April 1863, a fossil or coprolite human jaw, which was found by the workers employed in excavating coprolites near Ipswich, Suffolk. The jaw was purchased from the finder by Mr. John Taylor, druggist, of Ipswich, for the sum of 2s. 6d., who called my attention to it at the time, 1855. . . . The specific gravity [of the jaw bone] is much greater than that of a recent bone of the like size, it being infiltrated throughout its entirety with oxide of iron, and the surface presents peculiar metallic lustre. . . . I have now every reason to believe that this 'coprolite jaw' is the oldest relic of the human animal in existence, as its condition corresponds in every respect with the coprolites in whose contact it was found."

The history of this jaw, as narrated by Moir from Doctor Collyer's original paper, reads like a romance. Collyer was an American physician resident for many years in London. A man of exceptional intelligence, he became convinced that the jaw was a true fossil and that its geologic antiquity could be established beyond question. Like the Pilt-down skull of 1911 the Foxhall jaw of 1855 had been found by workmen. In their search of fertilizing material, the jaw was recovered in a roadside dump; it was presented to Collyer in 1857. Collyer

visited the quarry where the material was procured and noted that the quarry was sixteen feet below the surface. Dur-



Left—J. Reid Moir's interpretation of the most primitive stage in the flint industry, with seven small flakes struck off the left lateral surface. One third natural size. After Moir, 1920, Pl. V

Right—J. Reid Moir's interpretation (1920) of beak-keeled rostrum-carinate implement of Lankester. One third natural size. After Moir, 1920, Pl. IV

ing the succeeding decade he took the very steps we should take today by submitting the jaw for examination to the leading experts of England and France. In 1857 he showed it to Quekett, curator of the Royal College of Surgeons, and on Quekett's suggestion, to Richard Owen, the leading comparative anatomist of Great Britain, who kept it two years without expressing any opinion. In 1859 Collyer submitted it to the geologist, Prestwich, the first British authority to support Boucher de Perthes' discovery of Chellean man in France. Four years elapsed, during which appeared Sir Charles Lyell's work on *The Antiquity of Man* (1863), which led Collyer to take the jaw to Huxley, at the time foremost advocate of evolution and subsequent author of *Man's Place in Nature*. Later, at a meeting of the Ethnological Society (April, 1863), at which were present the great geologists Charles Lyell and Roderick Murchison, and the palaeontologist, George Busk, the latter stated that Collyer's specimen was "the jaw of some old woman, perhaps from some Roman burial ground," a statement he withdrew subsequently. Huxley, who was present, called on Coll-

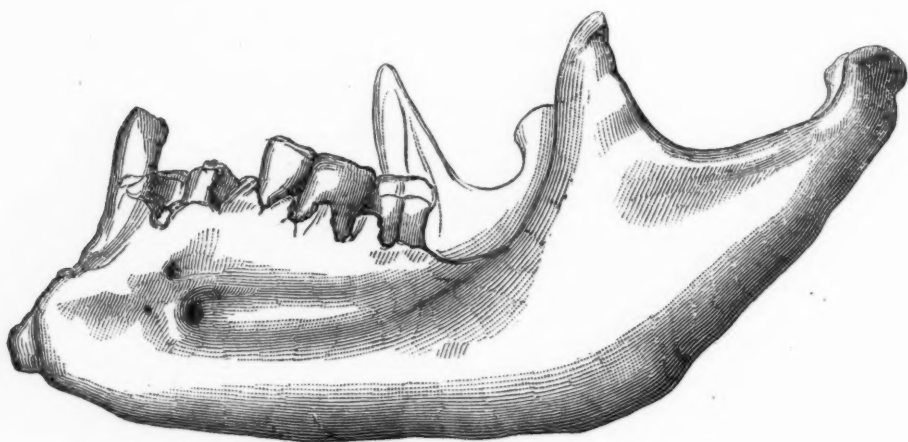
¹Moir, J. Reid. "Further Discoveries of Humanly-Fashioned Flints in and beneath the Red Crag of Suffolk." Reprint *Prehist. Soc. East Anglia* for 1920-1921, pp. 1-42, Pls. I-III, V, Figs. 1-45A.

²Collyer, Robert H. "The Fossil Human Jaw from Suffolk." *Anthropological Review*, Vol. V, No. XVII, April, 1867, pp. 221-220.

yer the following morning and pronounced the jaw to be a "most extraordinary specimen"; finally, however, Huxley wrote (May, 1863) to Collyer that the jaw bone showed "some peculiar characters," which, however, did not appear to him to be in themselves adequate to lead him to ascribe the bone "to an extinct or aberrant race of mankind, and the condition of the bone is not such as I should expect a crag fossil to be." Undiscouraged by Huxley's adverse opinion, Collyer submitted the

primitive and the degree of mineralization was not such as positively to prove it a fossil. He had a chemical analysis made which showed that the jaw was largely mineralized, but retained 8 per cent of animal matter; as to the degree of fossilization, Busk, agreeing with Huxley, wrote ". . . of course, without any relation as regards age with the fossil bones of the coprolite beds; it is of *very great antiquity*."¹

With our present knowledge and experience, it is difficult to understand



The alleged "coprolite jaw" attributed to the *sixteen-foot* level of the Red Crag deposits near Foxhall as figured by Collyer in 1867. Reproduced same size.

The best record of the alleged find is in a letter dated November 13, 1866, to Dr. R. H. Collyer from Mr. John Taylor, the original purchaser of the specimen from the workman in 1855: "From what I could learn at the time, from the agricultural labourer of whom I bought it, it came from the coprolite pit on the farm of Mr. Laws at Foxhall, about four miles from Ipswich, and was thrown out at Mr. Packard's manure factory with the coprolite from a cart or tumbrel, and from thence was brought to me to secure a glass of beer. . . . There is no doubt the bone was obtained at some depth . . . as I know the pit had been open for a considerable time when it was found."

jaw to the palæontologists, Hugh Falconer and Busk, who took it to Paris for submittal to Quatrefages and other French anatomists. Busk modified his original opinion and wrote (July, 1863) that he regarded the jaw as of "very great antiquity."

In brief, Collyer submitted his "coprolite jaw" to every great geologist and comparative anatomist of the time, but the results were mainly negative, probably because the shape of the jaw was not

why these great geologists and comparative anatomists did not immediately visit the spot from which the jaw was recorded, establish or disprove its geologic age, and endeavor to ascertain whether there was any reasonable doubt as to its actually having been found at the spot indicated. But Collyer was left alone with his discovery. He dis-

¹ On this question Moir reports that, on chemical analysis, it is found that some of the Red Crag bones contain as much as 6½ per cent of organic matter as compared with the 8 per cent reported in the Foxhall jaw.

appeared from scientific meetings and at the present writing we have no further record of either the enterprising doctor or the alleged Foxhall jaw. From inquiries instituted by Moir, it appears that Collyer was a graduate of the Berkshire School of Medicine, formerly at Pittsfield, Massachusetts, and a personal friend of the American craniologist, Doctor Morton, of the Academy of Natural Sciences of Philadelphia, with whom he corresponded about the jaw. It is hoped that, following up these clues, it may be possible to trace the history of Doctor Collyer after 1867, and furthermore that there may be a possibility of our recovering the lost Foxhall jaw.

It would be hazardous for the writer even to express an opinion as to whether this jaw is of Pliocene age. The imperfect figure reproduced on the opposite page shows it to be different from the two most ancient jaws we know, namely, those of the Piltdown and Heidelberg men, for it apparently had a prominent chin. It is possible that the mineralization of the jaw was due to deep intrusive burial. To settle these questions the *jaw must be traced and found*. Even if the jaw proves to belong to *Homo sapiens*, Doctor Collyer's paper has suddenly become a classic because it has led to the long awaited discovery of Tertiary man, which may now be described.

THE SIXTEEN-FOOT FOXHALL LEVEL

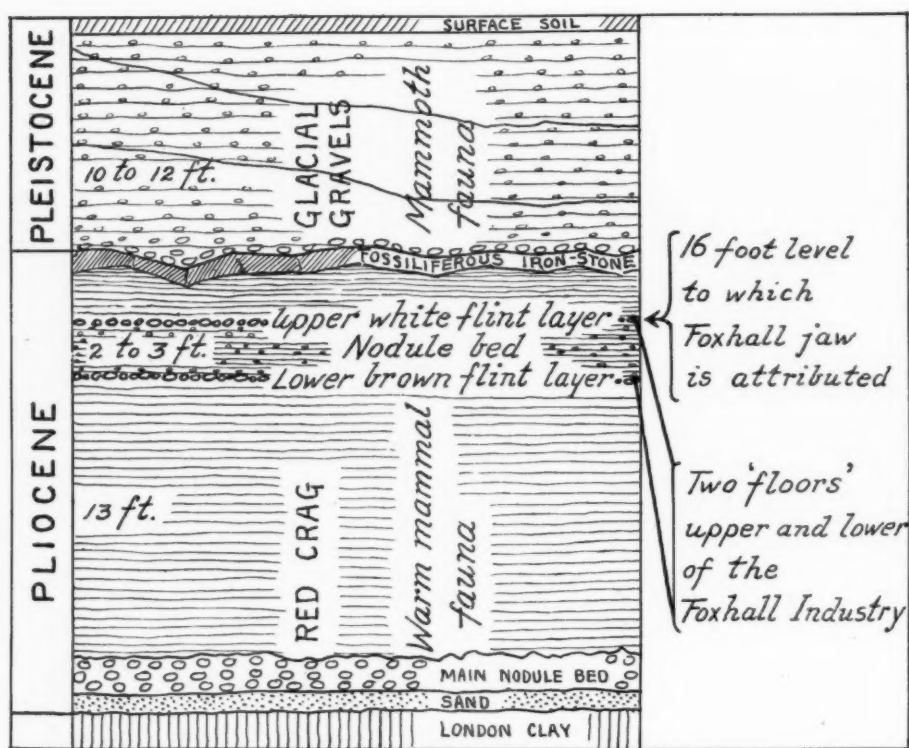
It remained for Moir, half a century later, to unearth Collyer's paper of 1867, to vindicate his entire procedure, and above all to rediscover the actual *sixteen-foot level* at Foxhall in which Doctor Collyer believed the jaw was located. "I found to my surprise," writes Moir, ". . . the occurrence of a nodule-bed lying in the [Red] Crag itself . . . and that this nodule-bed rested at a depth of sixteen feet below the surface." The exact correspondence, so far as depth from the surface is concerned, between the nodule-bed mentioned by Collyer

and that described in a Survey Memoir,¹ enabled Moir to trace the quarry to Mr. Laws' farm, mentioned by Collyer as in the parish of Foxhall. Moir continues: "I decided to investigate the nodule-bed. . . . My investigations have resulted in the discovery of a definite occupation level at this horizon, containing cores, flakes, flint implements, and a number of stones exhibiting crackling and other evidences of having been subjected to the action of fire."² It thus appears that Collyer's notes on the sixteen-foot level of the quarry, by attracting the intelligent and energetic archæologist of Ipswich, led to what we have described as the opening of a new epoch in archæology. To support this strong statement, let us compare the geologic age of the Foxhall flints with that of the flints discovered in 1846 by Boucher de Perthes at Chelles on the Marne River, France, at a geographic point approximately 230 miles southeast of Foxhall, England, the two localities in Stone Age time being united by a broad and fertile land connection. The most ancient of the Chellean flints are of much more recent time than those of Foxhall, because the greatest antiquity assigned to them by geologists is that of mid-Pleistocene time, whereas the Foxhall flints occur in the Upper Pliocene *before the beginning of Pleistocene time*. Thus the long interval of Lower Pleistocene time separates the Foxhall from the Chellean, during which the upper and middle river terraces of France and England were formed and important changes in the mammalian life occurred.

The makers of the Foxhall flints had their 'floor' or 'atelier' very near the shore of the North Sea in Pliocene time. The 'floor' is not in the base of the Red Crag but in the center of Red Crag sand deposits partly of river and partly of marine origin, which mark a very long

¹"The Geology of the Country around Ipswich, Harleigh, and Felixstowe." *Mem. Geol. Surv. United Kingdom* (explanation quarter-sheets), 1885.

²The italics are supplied by the author of the present article.



Diagrammatic section of the pit where the Foxhall Industry and "Jaw" were discovered. Modified from Moir, 1920-1921, p. 12, fig. 3. (See photograph on opposite page)

period of time and a very gradual change of climate in this part of England from warmer to cooler conditions. In the lowest levels of the Red Crag is found the warm Pliocene fauna of the three-toed *Hipparion* horse, the tapir, the short-jawed mastodon, the hippopotamus, and the roe deer, while in the upper levels occur the remains of a newer temperate fauna of true horses (*Equus stenonis*) and of the southern mammoth (*Elephas meridionalis*). Mr. Moir writes, August 11, 1921, apropos of a visit to the locality by Professor J. E. Marr, the geologist of Oxford University: "There is no question as to the Pliocene age of the Foxhall levels—so long as you continue to regard the Red Crag as Pliocene. But the 'floors' at Foxhall occur in the Crag, not at the base as in the case of the ordinary detritus bed." From the ground

level at the Foxhall Quarry occur the following beds:

- | | |
|------------|---|
| RECENT | A. Surface soil, 6 inches to 1 foot in depth. |
| QUATERNARY | B. Stratified "middle" glacial gravel 10-12 feet in thickness. |
| TERTIARY | C. Fossiliferous iron-stone bed, 6-9 inches in thickness. |
| Pliocene | D. Red Crag sand, horizontally stratified, 2-3 feet in thickness. |
| Red Crag | E. Sixteen-foot layer of Collyer. Black band with many casts of shells and flint implements, flint flakes, also "coprolites" and fossilized [Red Crag] bones, 2-3 inches in thick- |



Western face of the pit at Foxhall Hall in which the Foxhall industrial flint layers E and G were discovered, with the most ancient evidence of the use of fire by man.

Red Crag
(continued)

- ness. [See handle of shovel shown in the illustration.]
- F. *Nodule-bed* or gravel pit, horizontally stratified, containing coprolites, but *almost devoid of flints*, and 2-3 feet in thickness. [This is the bed quarried for fertilizing purposes, in which it is alleged that the "*Foxhall jaw*" was found.]
- G. **Lower black band**, not quite so well defined as "E," containing dark-colored, worked flints. [See bottom of measuring rod shown in the illustration.]

It is the level "E" which Moir describes as "*a definite occupation level . . . containing cores, flakes, flint implements,*

and a number of stones exhibiting crackling and other evidences of having been subjected to the action of fire."¹ It is these flints, discovered by Moir and identified as of human origin by Abbé Breuil, which firmly establish the existence of Pliocene man in Britain. That this was a working 'floor' is indicated by the presence of the flint cores and flint flakes with the flint implements themselves. The débris of this flint-working site appears to point to a time during the laying down of the Red Crag deposits, when for a short period, geologically speaking, a land surface in the form of a shore line existed at this site. The majority of the humanly flaked flints from both the upper and the lower levels, namely, "E" and "F," appear to belong to the same industrial stage. It may be, also, that after a more or less prolonged occupation of level "F," the incursion of the waters of the North Sea in late "Red Crag"

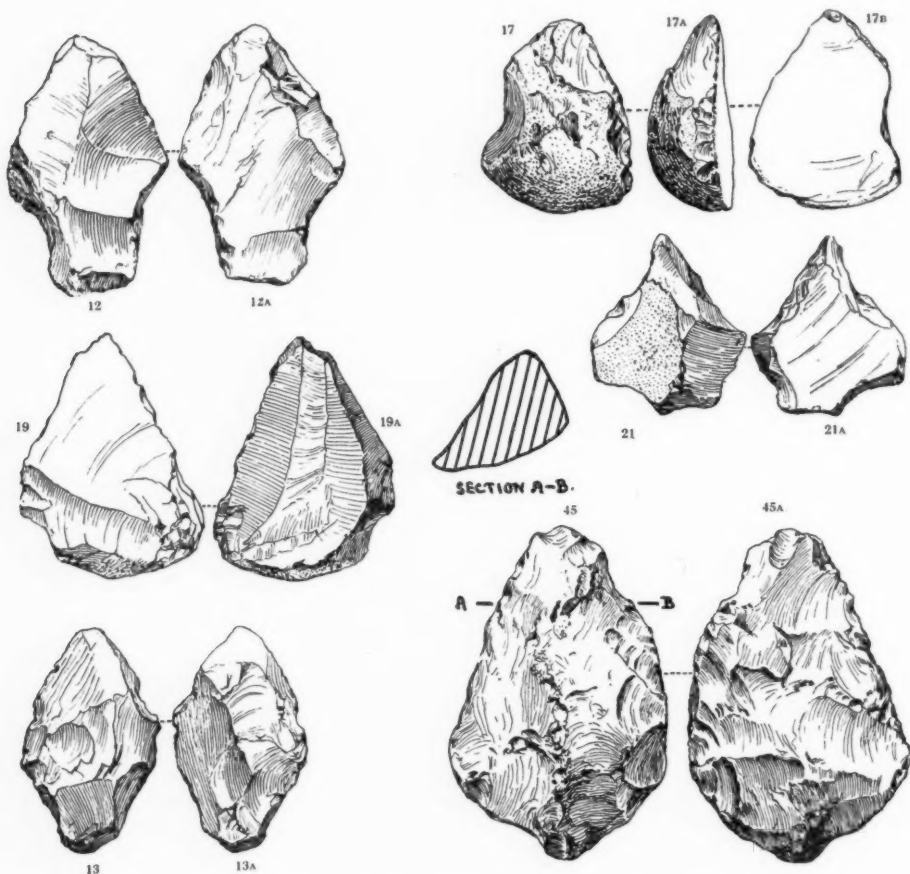
¹The italics are supplied by the author of the present article.

time caused the ancient flint workers to abandon their working site. Later, however, they returned to the same spot and worked on the upper surface of the nodule-bed, two or three feet in thickness. Finally, the upper floor was in its turn sunk below sea level and covered by a further deposition of marine sand and shells.

CHARACTER OF THE FOXHALLIAN FLINTS

These flints are unlike those of the

Chellean or pre-Chellean of France—they are chiefly fashioned from flakes and not from the "cores." Moir supposes that the almost pure white color is due to prolonged surface exposure of the 'floor,' because the flints lack the dark mahogany-brown coloration characteristic of the detritus layers beneath the Crag; only a few flaked flints of this dark color have been found. The known typical implements of the sixteen-foot



Five kinds of flint implements from the sixteen-foot 'floor' at Foxhall and one from the sub-Crag of Bramford. After Moir, 1920-1921.

12, 12A.—Two views of pointed flint implement flaked on the upper and lower surfaces and with constricted base, from sixteen-foot level of Foxhall pit. Primitive arrowhead type, which may have been used in the chase.

13, 13A.—Primitive (?) *coup de poing*, flaked on both sides, from Foxhall.

17, 17A, 17B.—Three views of an implement of the scraper type, known as the *racloir*, from sixteen-foot level of Foxhall. An implement which may have been used in preparing skins.

19, 19A.—Two views of a primitive *pointe* from the sixteen-foot level of Foxhall.

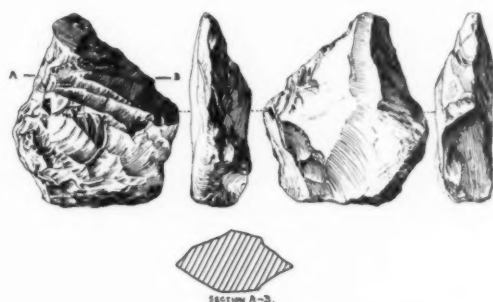
21, 21A.—Borer (*perçoir*) from sixteen-foot level of Foxhall.

45, 45A.—From sub-Crag, Bramford pit. Primitive (?) *coup de poing* or 'hand stone.'

level (p. 572) are not unlike those of much less antiquity than the Red Crag. Moir describes the flint tools and weapons as less coarse than the mahogany-brown specimens in the lower level. They include hafted specimens, side scrapers resembling the *racloirs* of early Moustertian time, a number of arrowhead-like *pointes*, also borers and scrapers of the ordinary type. A number of calcined flints are also found. Only one specimen of a "rostro-carinate" implement, of indifferent manufacture, was found during the excavations at Foxhall. Moir's praise of this industry is relative, but how shall we *explain* what the author terms "workmanship of a high order" in Upper Pliocene time, so long before what has always been regarded as the primitive

GIANT FLINTS BELOW THE FOREST BED OF CROMER

Fifty miles east of Foxhall is the ancient city of Cromer, now a popular seashore resort with a long and beautiful beach, stretching below high bluffs of sand and gravel surmounted by rolling downs, where at low tide is exposed one of the most famous mammal deposits in the world, long known to palæontologists as the *Forest Bed of Cromer*. The writer had the privilege of examining the fossils collected by Mr. A. C. Savin, of Cromer, who for years past has hurried to the seashore at every period of exceptionally low tide in order to collect from the rich harvest left by the erosion of the sweeping tides. The rich mammal-



An implement geologically older than any from Foxhall, found in the sub-Red Crag deposits of Bramford, which J. Reid Moir (November 21, 1921) considers very similar in appearance and technique to the flint implements found with the Piltown skull. After pen drawing by E. T. Lingwood. One third natural size

industry of Chelles? Only, it appears to the writer, by reforming our ideas of the antiquity of man; by preparing our minds for the discovery of still more ancient man and for a very early separation of human races as well as of industries.

Such openness of mind is rendered necessary by Moir's discovery of the *giant flints of Cromer*, of more recent geologic age than those of Foxhall, products of an industry of very different character and possibly the work of a different race.

ian life of the "Forest Bed" is more recent than that of the Red Crag; the short-jawed mastodons (*M. arvernensis*) and other south temperate forms are extinct; the two great elephants of Lower Pleistocene time, the "southern" and the "straight-tusked," have arrived in East Anglia; the Etruscan rhinoceros lingers. It is perhaps to hunt these monsters that a giant flint industry is developed of which 'floors' are discovered at Cromer and at Sheringham five miles to the northeast.

These flints were first mentioned by

Sir Ray Lankester,¹ who has in recent years described the large "beak-keeled" implements which he terms rostro-carinates. The human origin of these rostro-carinates is disputed by some archæologists; it is denied by others such as Abbé Breuil. What Lankester terms his *test* rostro-carinate was seen by the writer in the British Museum and has been figured. Lankester, more-

among a great number of very large worked flints, recently discovered by Mr. Reid Moir below the forest-bed at Cromer in such a position as to indicate a workshop or flint-workers' 'floor'—of an age anterior to that of our river-terrace gravels. . . . The largest of the worked flints from this newly-discovered 'floor' weighs 7 lb. 6 oz., is 10 inches in length, 5½ inches broad and at the 'butt' end is 4 inches thick. It



Two views of one of the giant flint implements found at low water at Cromer, resembling a giant Chellean *coup de poing*. One third natural size. After a wash drawing by E. T. Lingwood kindly forwarded by J. Reid Moir (November 21, 1921) for reproduction in NATURAL HISTORY

over, has given the strongest backing to Reid Moir's excavations and researches, culminating in his advocacy of the human origin of the "Forest Bed" giant flint implements, of which he writes² (1921, p. 166):

"The second is the most remarkable

has a rostrate form, a relatively flattened ventral surface and is richly worked all over by large coarse flaking of indubitable human origin. It presents a marked resemblance—both in general form and in the character of the flaking of its surface—to the Selsey rostrate as well as in its great size and weight. The point to which I wish to draw attention in regard to these three unusually large and heavy flint implements, is that they belong to a very early period, antecedent to that of the familiar tongue-shaped and

¹Lankester, E. Ray, "On the Discovery of a Novel Type of Flint Implement Below the Base of the Red Crag of Suffolk," . . . *Phil. Trans.*, B, April, 1912. Vol. 202, p. 332.

²Lankester, E. Ray, "A Remarkable Flint Implement from Selsey Bill," *Proc. Roy. Soc.*, B, Vol. 92, 1921, pp. 162-168, Pls. VIII-XI.



Cliffs of Cromer. The Forest Bed deposits are found at low tide all along this beach. The 'floor' where the Cromerian industry occurs is just beyond the pier, near the horizon (upper picture). Since the 'floor' is below the Forest Bed, it is best shown at extremely low tide

ovate implements of Chellæan and Acheulæan age. . . . The early age of these big implements is consistent with the hypothesis that they were made and used by an early race of men of heavier build than that which succeeded them and produced the abundant ovates

and tongue-shaped implements of our terrace gravels. Whether made by an exceptionally big race or by men of the modern size, the use of heavy big flint implements, such as the two which I have here cited, presents a problem. If used merely as hammers or as club-

heads they would be unwieldy and would not require any special shaping—such as would give precision to a smaller implement. The only suggestion I can offer as to their use besides that of ‘pounding’ or breaking into the cavities of the bones of large animals in order to extract marrow, brain, etc.—is that they were employed either affixed to a handle or held by the two hands for the purpose of breaking a hole in the ice on the surface of a lake or marsh pool. Fish come to such openings in the ice and are then readily speared or captured.”

While at Cromer, the writer examined these flints, which have been collected at low tide in very large numbers and un-

fortunately are being somewhat scattered among amateur collectors. This supposed sub-Forest Bed ‘floor’ should be guarded as a *national monument*, because *if* the human origin of these flints is incontestably proved, the ‘floor’ will at once become one of the *most famous spots in the early history of Great Britain*. Only the most expert archæologist and student of flint mechanics and lines of fracture is competent to express an opinion. If proven authentic beyond dispute, these ancient stations will rank like Chelles and Le Moustier as types of two new human cultures—which may be known respectively as **Cromerian** and **Foxhallian**.



The large “Selsey rostro-carinate,” right lateral surface. After Lankester, 1921, Pl. 10. This is a sub-Red Crag implement, more ancient in age than Foxhall.

Lankester defines the ideal rostro-carinate as an implement with broad posterior region, narrowed anteriorly to a quasi-vertical cutting edge. This anterior narrow edge is strongly curved and gives the implement the form of the beak of an accipitrine bird. The form of this region of the implement may also be compared to that of the prow of a boat (the boat being turned keel upwards). If the implement is held with the prow or beak to the front, there are observed an upper or dorsal plane, a lower or ventral plane, a right lateral and left lateral surface, a posterior surface or stern, and an anterior surface.

Cort.—An area of cortex or original bark of the nodule.

2, 3, 4.—Scars whence ribbon-like flakes have been struck; scars 3 and 4 are noticeable for the conchoidal transverse rippling of the flint.

5.—The scar of a broader flake, parallel to 2, 3, 4, which is truncated by the well-marked conchoidal scar, 6 of another shaping-flake

THE DAWN MAN OF PILTDOWN, SUSSEX

BY

HENRY FAIRFIELD OSBORN

EOANTHROPUS, the 'dawn man' of Piltdown, has had a battle royal for recognition by the scientific world. Since the first fragments of his skull were reported in 1911 by the geologist, Charles Dawson, and first made known to the scientific world in 1913¹ by Dawson and Arthur Smith Woodward, the latter Keeper of Fossils in the British Museum, the contest of opinion has been long and heated and at times acrimonious. Over a few fragments of skull bone, three teeth, and a portion of the jaw, the wise anatomists of Great Britain, of western Europe, and of the North American continent have expressed opinions of every variety.

The writer's peace-loving friend, Smith Woodward, started the fracas by giving these fragments the name *Eoanthropus*, signifying 'dawn man,' and thereby committed himself to the idea that here was a new genus of man quite distinct from the genus *Homo* and the antipode of the species *Homo sapiens* to which we belong. To the ideas of the other extreme, Marcellin Boule, the French palaeontologist, resolutely adhered, namely, that the fragments do not represent a 'dawn man' at all, that they belong to the same genus *Homo* as ourselves, that the species may be known as *Homo dawsoni*, that it is of relatively recent geologic age, namely, of the Third Interglacial period and Acheulean culture phase. Moreover, Boule joined a chorus of American and German opinion that the jaw does not belong with the skull, but is that of a chimpanzee, and that the skull itself in brain capacity is that of a relatively recent type. This opinion has been reaffirmed by Boule in his great work of 1921, *Les Hommes Fossiles*,² in which all the discoveries of

fossil human remains are reviewed from beginning to end in the most searching manner, and in which the chronologic succession of the human fossil types is clearly set forth on the forty-ninth page.

Thus the 'dawn man' has shared a fate similar to that of Neanderthal man, first discovered by some workmen in 1856 and described by Schaaffhausen in 1858—especially through the skull-cap, thigh bones, and other skeletal fragments—and received with almost universal scepticism. The Neanderthal man was regarded as a feeble-minded modern by the high German authority, Virchow, and was treated very lightly even by Darwin in his great work, *The Descent of Man*, published in 1871, although the geologist Lyell (1863) had recognized him as an intermediate form between man and the apes. Huxley, however, (1863, 1864) did not recognize the Neanderthal man as the missing link, his opinion being as follows (1864, p. 588): ". . . there is no ground for separating its possessor specifically, still less generically, from *Homo sapiens*. At present, we have no sufficient warranty for declaring it to be either the type of a distinct race, or a member of any existing one; nor do the anatomical characters of the skull justify any conclusion as to the age to which it belongs." When we recall the fact that the 'Gibraltar skull' of a female Neanderthaloid had been known since 1848, we may say that the Neanderthal man was under a cloud of suspicion for nearly forty years, that is, until 1887, when the discovery was made of two Neanderthal skeletons and skulls in a grotto near Spy, not far from Dinant, Belgium. It was these Spy relics, which seem to agree exactly with the Neanderthal skull top and with

¹Dawson, Charles, and Woodward, A. S. "On the Discovery of a Palaeolithic Human Skull and Mandible in a Flint-bearing Gravel overlying the Wealden (Hastings Beds) at Piltdown, Fletching (Sussex)." With an Appendix by Prof G. Elliot Smith. *Quart. Journ. Geol. Soc.*, London, Vol. LXIX, 1913, pp. 117-151, Pls. 15-21. *Ibid.*, Vol. LXX, 1914, pp. 82-99.

²Boule, Marcellin. *Les Hommes Fossiles. Éléments de Paléontologie Humaine*. Paris, 1921, pp. i-xi, 1-491, figs. 1-239.

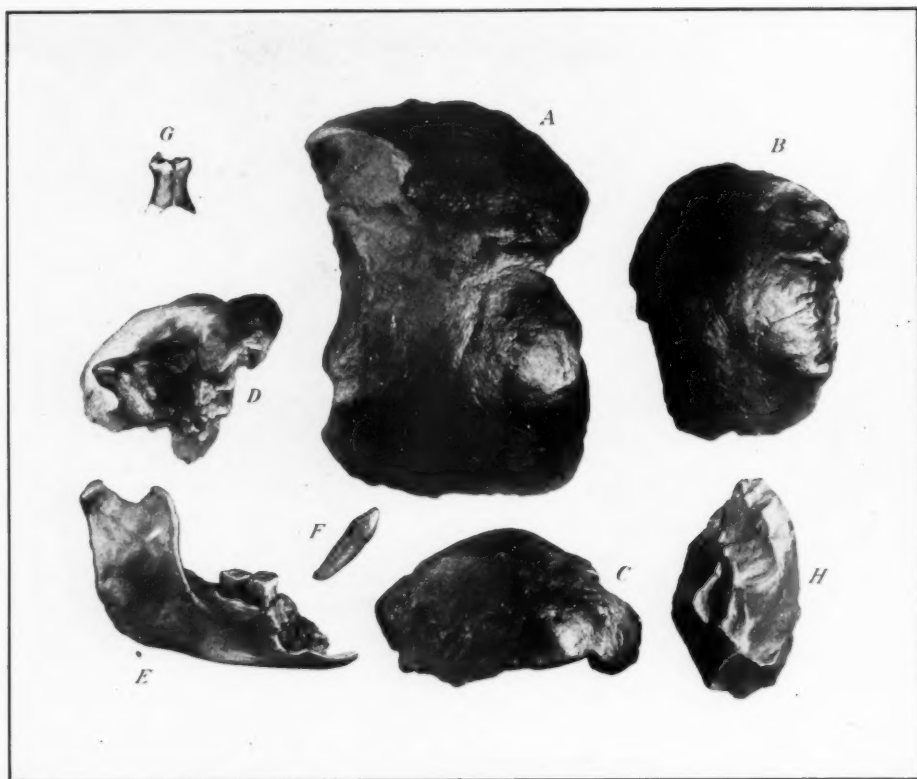


Fig. 1. All that was found of the fractured Piltdown skull, during the years 1911-13, from which the complete skull was restored as shown in Figs. 2a, 2b, 3a, 3b, 14.

A, B, C, D, skull fragments found by Dawson and Smith Woodward in 1911, 1912. E, jaw fragment found by Dawson in 1912. F, canine tooth found by Father Teilhard de Chardin in 1913. G, nasal bones found by Dawson in 1913. H, single worked flint found near original skull fragments by Smith Woodward. Jaw one third natural size; other fragments a bit larger than one third (distorted somewhat by camera.)

subsequent discoveries in other localities, that firmly established the Neanderthal race as one of the most important, and now by far the best known, of all fossil men.

Trinil man, the *Pithecanthropus erectus* or 'erect ape-man' of Java, is still suffering under the same uncertainty. The original discovery, singularly parallel to that of Neanderthal man, consisting of the skull top, a thigh bone, and two grinding teeth, has remained unique evidence for the past thirty years. Strenuous efforts to discover more material on the banks of the Bengawan River, where the original remains were recovered by the Dutch army sur-

geon, Eugen Dubois, in 1891, have been unavailing. A singular misfortune has attended the Trinil man in that for some mysterious reason Dubois, the discoverer and possessor of the remains, has never made them fully known to science. There are riches of knowledge and information locked up in those four fossils which could be released through the application of the most modern methods of research, but which are held back. The anatomists of the world have implored Doctor Dubois to publish all the information in his possession, or to subject these precious documents to the examination of other men—but in vain. In the meantime, renewed ef-

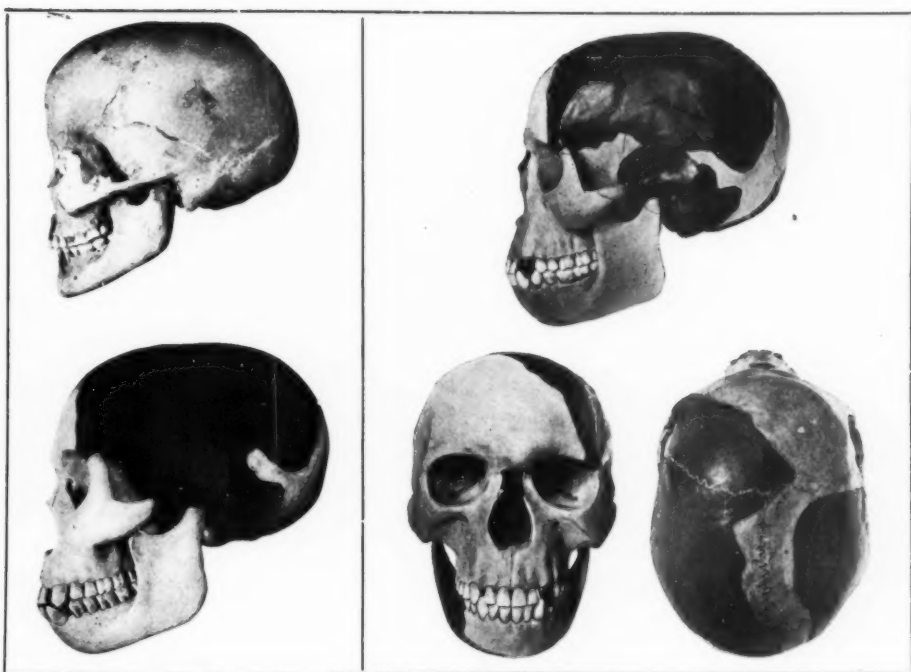


Fig. 2a. Original restoration of Pilttdown skull (lower) made by Smith Woodward in 1913; one fifth life size. Skull of South African Bushman (upper), exhibiting the contrast between *Eoanthropus* and *Homo* type in the forehead region, also in the angulation of the jaw. After Osborn, *Men of the Old Stone Age*, Fig. 67

Fig. 2b. Three views of the Pilttdown skull as reconstructed by J. H. McGregor, 1914; one fifth life size. This restoration includes the nasal bones discovered in 1913 and the canine tooth also discovered in 1913, which were not known at the time of Smith Woodward's reconstruction of the same year. (Upper) profile view; (lower left) front view; (lower right) view of the top of the cranium. After Osborn, *Men of the Old Stone Age*, Fig. 68

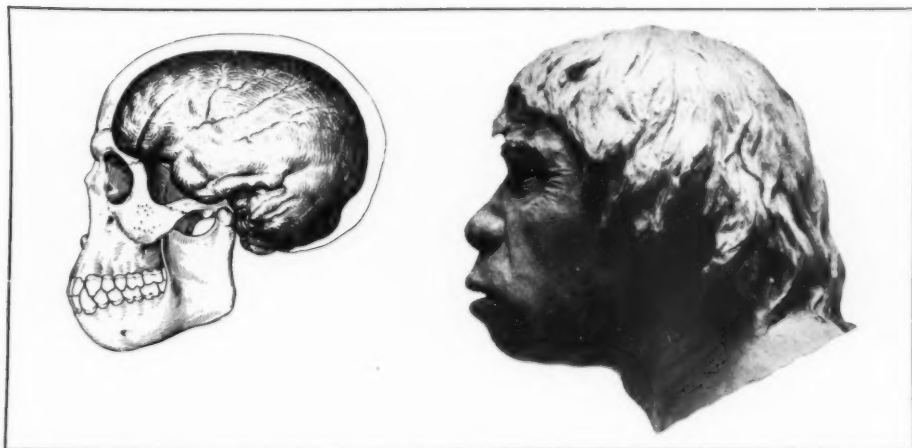


Fig. 3a. Pilttdown skull with left half removed to display the extreme thickness of the bones and the shape of the brain. As restored by J. H. McGregor, 1914; one fifth life size. After Osborn, *Men of the Old Stone Age*, Fig. 69

Fig. 3b. Restoration of the head of Pilttdown man; in profile, based on the reconstructions shown in the above figures. After a model of 1914 by J. H. McGregor; one fifth life size. After Osborn, *Men of the Old Stone Age*, Fig. 71

forts will be made to discover in Asia additional remains of the same geologic age, especially by the expeditions that are being sent out by the American Museum of Natural History through the funds of the Third Asiatic Expedition.

May these efforts be crowned with success! May Dubois reveal the secrets in his possession! If so, we shall probably confirm his original opinion that the *Pithecanthropus* is of Upper Pliocene age; that it possessed the straight femur of a biped-walking type and not of a tree-climbing type—thus corroborating the specific appellation *erectus*; that the brain is far larger than that of any kind of anthropoid ape, and that the skull possesses distinct resemblances to that of the Neanderthal race of men—in brief, that *Pithecanthropus* is related, even if indirectly, to one of the great lines which gave rise to the true human species.

The history of anthropology does not include any story of exploration, discovery, and research more worthy of recognition and praise than that connected with the 'dawn man.' Arthur Smith Woodward, who took a very bold step in originally proposing the Piltdown man as belonging to the new genus *Eoanthropus*, has not stopped to reply to any of his critics; he has left this to some of his colleagues, who have replied with considerable warmth, while he himself has been unremittingly engaged for the past seven years in endeavoring to secure material to confirm his original description and estimate of the characters of the 'dawn man.' The locality, which the writer will describe presently from his own recent visit, July 26, 1921, presents exceptional difficulties, chiefly because the Piltdown gravels are almost exactly of the same color as the fossils which they contain; the fossils are thus extremely inconspicuous. From prolonged experience in fossil hunting during the past forty years in various parts of the world, the writer can truthfully

say that he knows of no locality where fossil remains are so indistinguishable from the matrix in which they are found. Under these conditions the discovery of the original fragments of the skull was all the more creditable; the subsequent finding of the jaw fragment by Dawson marked the turning point in the whole history of the discovery; the finding of the canine or eye tooth by Father P. Teilhard de Chardin indicated an almost hawklike vision; finally, the unearthing of the two minute black-colored nasal bones of the 'dawn man' was almost a miracle.

Alongside the roadway leading to the Manor House, where the original find was made, the workings, 150 feet in length and 10 feet in width, have been carried on at intervals for ten years. Every pound of Piltdown gravel has been gone over minutely, or sifted, under Dr. Smith Woodward's immediate supervision. Openings have been made on the other side of the hedge, revealing the same Piltdown gravel and the same superposed layers as shown in our section (Fig. 7) without the discovery of another fragment of bone. Only during the season of 1921 was there a cut made beneath the adjacent roadway within a short radius of the very spot where the bones of the skull and jaw lay. The rewards of this exhaustive and exhausting work, which throughout has required infinite patience and persistence, have been few and far between, but sparse as the new evidence is, it has all been in the direction of gradual confirmation and strengthening of the original Dawson-Smith Woodward discovery—a discovery of transcendent importance to the prehistory of man.

Scepticism as to the association of the chimpanzee-like jaw with the skull was very widespread. In the original description Smith Woodward himself proclaimed the resemblance of the jaw to that of a chimpanzee. The present writer was one of the American school of sceptics who finally reached the opinion that this

was an instance of the accidental association of two wholly unrelated fossils. It would have been difficult to dislodge this opinion, so widely entertained in Europe and America, but for the overwhelming confirmation afforded to Smith Woodward by the discovery, announced in 1917,¹ of the remains of a *second Piltdown*

is not a shadow of difference. As shown in the accompanying photograph published by permission of Dr. Smith Woodward, the two grinding teeth differ only in respect to age. The first Piltdown man was more advanced in years and the teeth were more worn; the second Piltdown man was younger and the teeth

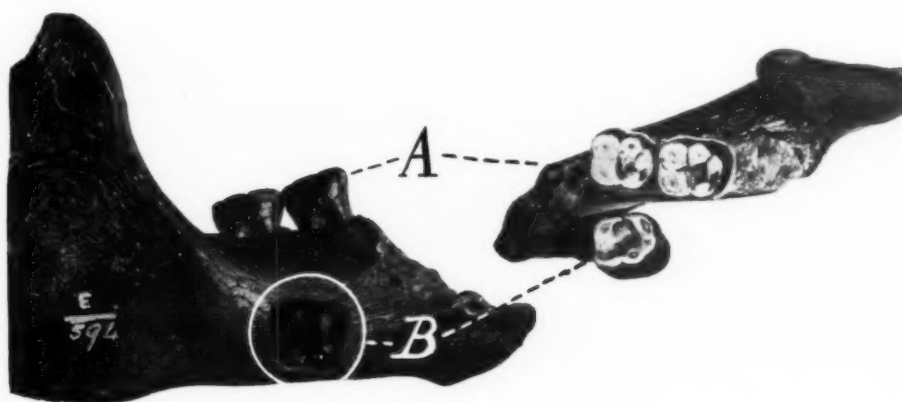


Fig. 4. A—side and top views of jaw of first Piltdown man, with first and second lower molar teeth in place. B—side and top views of first lower molar tooth of second Piltdown man. About three fourths life size

man, not in the original quarry but at another exposure of the Piltdown gravels about two miles distant, a discovery made by the original finder, Dawson. If there is a Providence hanging over the affairs of prehistoric men, it certainly manifested itself in this case, because the three minute fragments of this *second* Piltdown man found by Dawson are exactly those which we should have selected to confirm the comparison with the original type, namely: (1) a first lower molar tooth, (2) a bit of bone of the forehead near the right eyebrow, (3) the middle part of an occipital bone of the skull. Both the grinding tooth and the eyebrow region are absolutely distinctive. Placed side by side with the corresponding fossils of the first Piltdown man they agree precisely; there

were unworn; but they present precisely the same characters.

Smith Woodward very quietly published this confirmatory evidence without, however, alluding in any way to his critics or yielding to the natural temptation of writing, "I told you so," a phrase which would certainly have appeared from a less patient and dignified pen. Seeing is believing, and the writer eagerly looked forward to a return to the British Museum after so many years of absence and to the opportunity of examining these precious documents, an opportunity which was most cordially extended to him by Doctor Woodward. After attending on Sunday morning, July 24, 1921, a most memorable service in Westminster Abbey, a building which enshrines many of the great of all time, the writer repaired to the British Museum in the afternoon to see the remains of the now thoroughly vindicated

¹Woodward, A. S. "Fourth Note on the Piltdown Gravel with Evidence of a Second Skull of *Eoanthropus dawsoni*." With an Appendix by Prof. G. Elliot Smith. *Quart. Journ. Geol. Soc.*, London, Vol. LXXIII, 1917, pp. 1-10, Pl. I, figs. 1, 2.



Fig. 5. Most Ancient Stone Age Sites of England and France from East Anglia to Chelles. East Anglia—Norfolk, Suffolk, Essex, and Sussex—with the chief localities, Piltdown, Foxhall, and Cromer, in which the most ancient evidence of man on the earth has recently been discovered

icated 'dawn man' of Great Britain. From a steel fireproof safe, these few precious fragments of one of the original Britons, which had been preserved in this manner from the bombs thrown by German aviators, and which will prob-

ably be thus guarded from thieves for all future time, were taken out and placed on the table by Doctor Woodward, so that full and free opportunity was given for the closest comparison and study. At the end of two hours, in which also worked flints and a large implement of cut *Mastodon* thigh bone were examined, the writer was reminded of an opening prayer of college days, attributed to his professor of logic in Princeton University: "Paradoxical as it may appear, O Lord, it is nevertheless true, etc." So the writer felt. Paradoxical as it appears to the comparative anatomists, the chinless Piltdown jaw, shaped exactly like that of a chimpanzee and with its relatively long, narrow teeth, does belong with the Piltdown skull, with its relatively flat, well formed forehead and relatively capacious brain case!

First, however, let us look over the ground of the original Piltdown discovery, as the writer was privileged to do in company with Doctor Smith Woodward and Dr. H. M. Ami, Canadian geologist, to whom he is indebted for certain of the accompanying photographs.

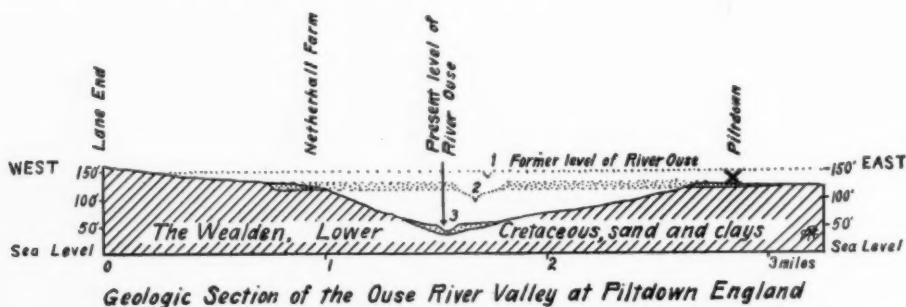


Fig. 6. Piltdown Common lies between two branches of the River Ouse, about 35 miles south and slightly to the east of Gray's Thurrock, the Chellean station of the Thames. To the east is the plateau of Kent, in which the flints described as 'eoliths' were discovered by Benjamin Harrison about 1870. The Piltdown gravel containing the Piltdown skull underlies the Piltdown Common, a well-defined plateau of large area lying about 80 feet above the present level of the main stream of the Ouse. Kennard believes that the Piltdown gravels are of the same age as those of the 'high terrace' of the lower valley of the Thames, namely, the 90-100 foot terrace; this would make the Piltdown industry much more ancient than the Chellean, which belongs on the 30 foot terrace. Clement Reid also holds that the Piltdown gravels are of First Interglacial age, equivalent to the 90-100 foot terrace, long prior to the arrival of the Scandinavian glacier in Great Britain. Dawson in his original description also broadly assigns the Piltdown skull and jaw to the first half of the Pleistocene epoch.

×—Piltdown on (1) the former level of the River Ouse, which has since descended to (2) lower levels and (3) its present level

Piltdown on the Ouse is not very far from the famous Chellean stations of the ancient Somme and Marne rivers of France and not many miles south of Gray's Thurrock on the Thames. To the north, in ancient East Anglia, were the stations of the Foxhallian and Cromerian industries, described in the previous article, and the site of the discovery of the alleged Foxhall jaw. It is, therefore, altogether natural from the geologic standpoint to compare the three or four true flints which have been found with the Piltdown man with those of the earliest Chellean station on the Somme and of the *Champ de Mars* near Abbeville, described by d'Ault du Mesnil, and of those of Foxhall, to the north, recently described by J. Reid Moir.¹ While this article is in press, the latter comparison is actually being made.

The Anderida forest of Roman invasion times, formerly covering the Piltdown Common, is thus described by Elton:²

"The great marshes were still unbanked and open to the flowing of the tide . . . and several hundreds of square miles were covered by the dense forest of Anderida. This forest must at one time have covered most of south-eastern Britain. . . ." This is otherwise known as the forest of "Andredesweald," the name Weald being given to the Wealden clay.

Many thousand years earlier, flowing through a warm temperate forest, was the ancestral River Ouse, transporting the Piltdown gravels, which, although of very moderate thickness (20 inches to 2 feet) at the widest part, spread out like a fan or river delta beneath the Common over a considerable area and are instantly recognized by the dark brown, compact sands and pebbles, which are sought by road-makers for their excellent road-building qualities.

¹Moir, J. Reid. "Further Discoveries of Humanly-Fashioned Flints In and Beneath the Red Crag of Suffolk." *Prehist. Soc. East Anglia*, 1920-1921, pp. 1-42 (reprint), Pls. I, II, III, V, Figs. 1-45A.

²Elton, Charles, *Origins of English History*. London, Quaritch, 1882, pp. 106

In approaching the famous site one passes over a rolling open plain covered with patches of heather, now serving as a golf course. On the horizon are the elevated North Down and South Down overlying bluffs of flint-bearing chalk, which, in turn, are superposed on beds of Wealden age, as shown in the accompanying sketch (Fig. 8). At Piltdown meandered the ancient Ouse, and the gravels were subsequently covered with four layers, as shown in the sketches made by the writer. It is necessary, however, to take a bird's-eye view of the ground from above in order accurately to locate the very spot where

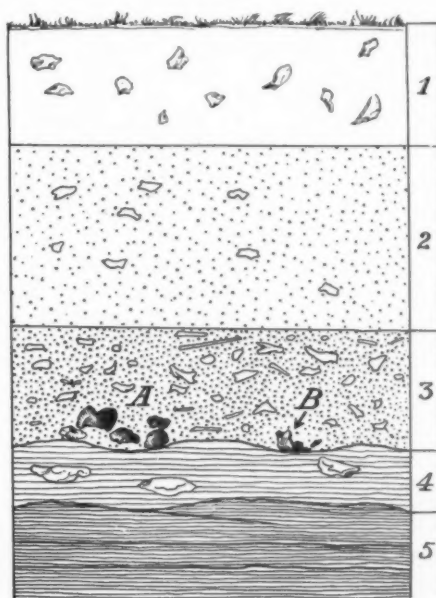


Fig. 7

1. Recent humus and surface soil, with scattered flints, 12-20 inches.

2. Pale yellow sandy loam with gravel and Neolithic flints and pottery, 2 feet 6 inches.

3. Piltdown gravel containing remains of the skull (A), jaw (B), and teeth from the lower level, also worked flints and rolled water-worn fossils, probably of Pliocene age. 18-20 inches.

4. Pale yellow clay and sand with scattered potato-shaped flints unworked. The bone tool implement was found at the bottom of this layer, 10 inches.

5. Undisturbed strata of Lower Cretaceous (Wealden age), over the surface of which flowed the stream bearing the clays and Piltdown gravels

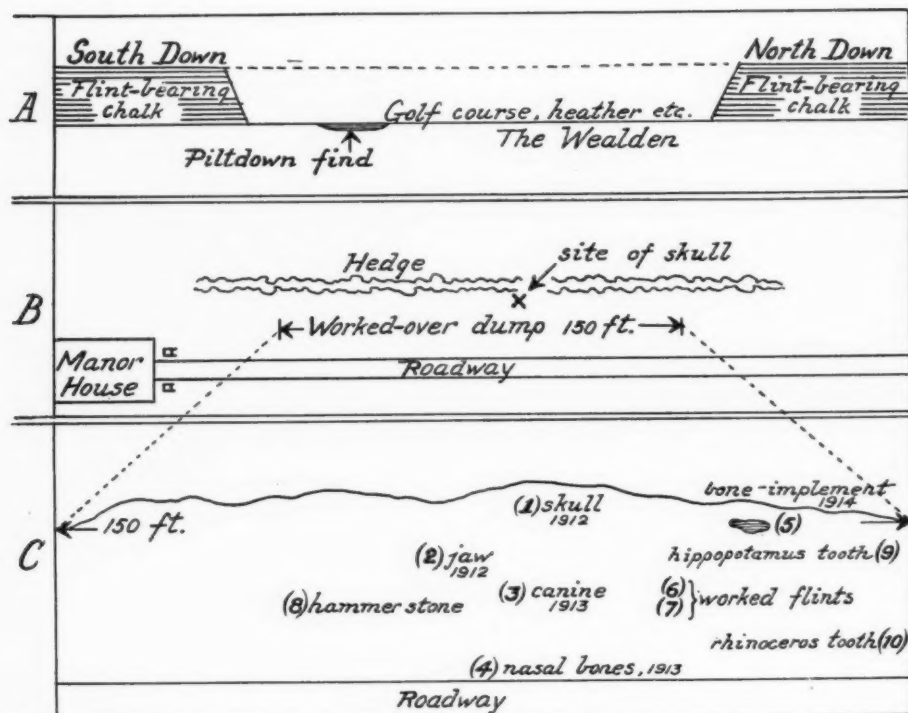


Fig. 8. Sketches by the writer (1921) showing the Piltdown workings. A—General relations of the "Downs" to the Piltdown find. B—The Piltdown gravel workings from 1912 to 1921. C—Relative location of some of the principal finds. Skull and jaw parts found near together. (1) Skull fragments in the workman's dump, (2) jaw, (3) canine, and (4) nasal bones, picked out of the undisturbed gravel near by, (5)–(10) flints and fossil bones scattered

the skull was found and to appreciate the immense amount of work that has been done since 1911 in searching for additional evidence.

Even during the past summer, without any subvention or state aid, Dr. Smith Woodward has been quietly continuing his work and he wrote October 24, 1921: "I did a little more digging last month, but without result."

It will be recalled that the working of this Piltdown gravel pit has been going on for many years. The successive order of discovery is approximately as follows:

1911 (reported)

Unusually thick human parietal bone was found by Dawson.

1911 (autumn)

Dawson picked up another and larger

piece of bone belonging to the forehead region of the same skull and including a portion of the ridge extending over the left eyebrow.

1911–1912

At various times there were found by Dawson and Smith Woodward rolled or abraded flints, known as 'eoliths,' also rolled or abraded remains of the hippopotamus, the rhinoceros, and of a stegodont proboscidean, claimed to be of greater age than the Piltdown gravels, possibly of Pliocene Red Crag age.

At various times also there were unearthed (1) a Palaeolithic hammer-stone (see Fig. 8, No. 8) found in the undisturbed gravel, (2) freshly worked flints, discovered by Dawson in the Piltdown gravel dump (Fig. 12), and (3) the flint found by Ray Lankester. These flints are extremely important, because they are of the same geologic age as Piltdown



Fig. 9. Type of locality where the Piltdown skull fragments were found. Dr. Smith Woodward and Mr. Charles Dawson washing gravel in search for more fragments and teeth; a workman standing on the exact spot of the original discovery, where a monument will be placed. Enlarged from a film made in the year 1912, under the direction of Dr. J. Leon Williams, who presented to the American Museum the Williams collection of prehistoric crania

man and can be compared with those of Foxhall and of the pre-Chellean of the Somme.

1912

Dawson and Smith Woodward began systematic search. All material was looked over and carefully sifted; it appeared that the whole or greater part of the human skull mentioned above had been scattered by the workmen, who had thrown away the pieces unnoticed.

One Sunday evening the blow of a pick caused the right half of a jaw to fly out of the undisturbed bottom of the gravel bed. The fore part of the jaw had apparently been cut off by the long previous blow of a workman's pick. A yard from the jaw an important piece of the occipital bone of the skull was found.

1913

A single right lower canine tooth, ape-like, was unearthed by Father P. Teilhard de Chardin, the French anthropologist.

A pair of minute nasal bones were found, also the turbinal bones of the nasal region.

1914

A bone implement, partly shaped at one end out of a proboscidean thigh bone, was discovered in the clay layer beneath the gravel.

1915

Discovery by Charles Dawson of fragments of second Piltdown man, two miles distant from original pit.

1915-1921

Annual visits and continued exploration, excavations, and sifting of materials, not rewarded by any further discovery, by Smith Woodward.

It is now generally agreed that Osborn and McGregor were mistaken in placing in the upper jaw the canine tooth, discovered by Father P. Teilhard de Chardin in

1913; that the canine belongs with the right lower jaw and in so far is confirmatory of the union of the jaw with the

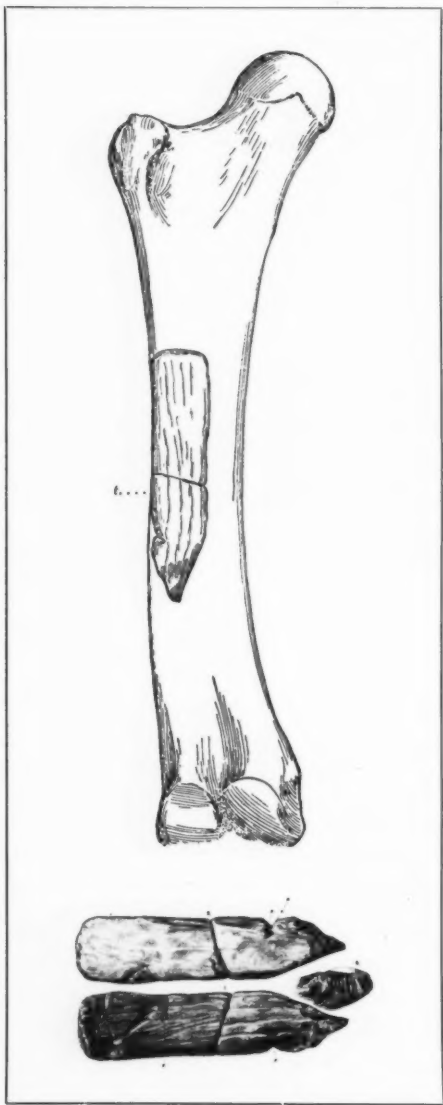


Fig. 10. Partly shaped bone tool cut from the thigh bone of a mastodon or mammoth, discovered in the clays underlying the Piltdown gravels by Smith Woodward in the year 1914,—a partly finished tool which may have been designed for purposes of hide dressing. One twelfth natural size. After Smith Woodward

skull. Consequently the photograph (Fig. 14) of the right side of the skull, with the canine in place, represents the latest opinion¹ as to the reconstruction of the skull. This reconstruction involves especially the size and weight of the brain through the determination of the median line of the top of the skull or the location of the so-called sagittal suture, as clearly shown in Fig. 2b. Brain size is one of the points about which has raged the greatest controversy. It is interesting now briefly to recall:

1913

Smith Woodward estimated the brain size as 1070 cubic centimeters.

Arthur Keith, the distinguished comparative anatomist, maintained that when the skull was properly reconstructed, the brain capacity would be found to equal 1500 cubic centimeters.

Elliot Smith and Smith Woodward maintained that the brain measured nearly 1300 cubic centimeters, equaling the size of the smaller human brains of

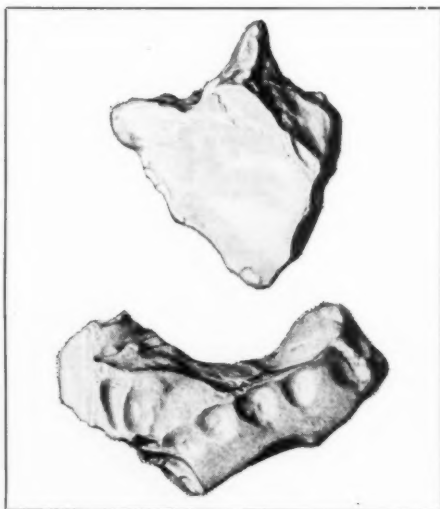


Fig. 11. Rolled flints termed 'eoliths' found by Dawson in or near the Piltdown gravel pit. After Dawson. After Osborn, *Men of the Old Stone Age*, Fig. 66. One half actual size.

Borer type (above)
Curved scraper (below)

¹A recent comparison of the single canine tooth has convinced Doctor Gregory, Doctor Hellman, and the writer that it most nearly resembles the *right lower canine* of a female gorilla of relatively small size. It is very unlike a *human canine* in form and proportion. The doctors still disagree, for Doctor McGregor, another expert, feels strongly (December 15, 1921) that the identification of the Piltdown canine is a very uncertain matter.

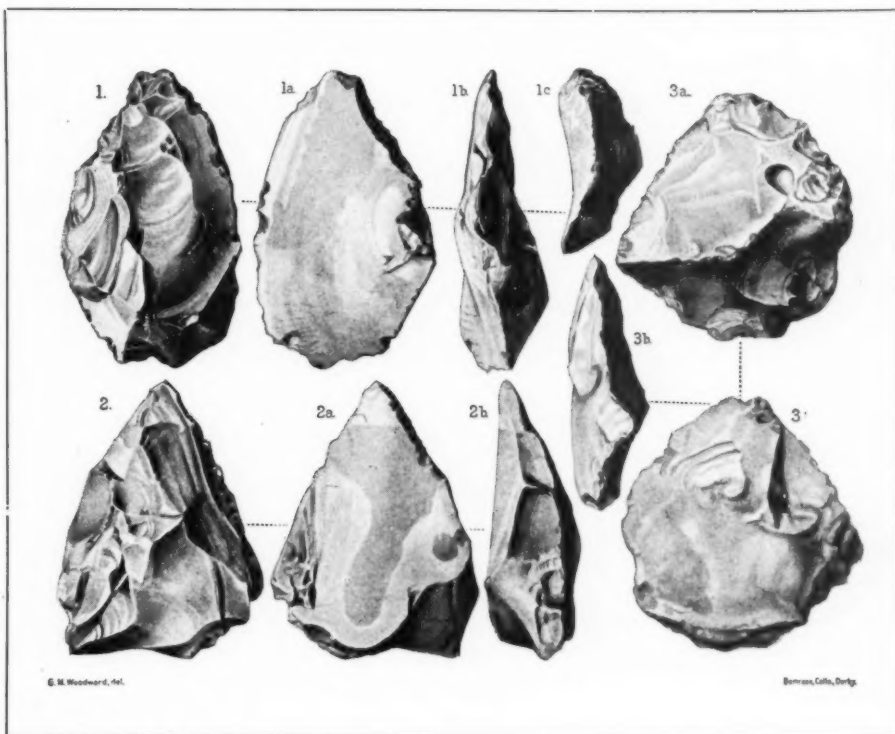


Fig. 12. Three freshly chipped triangular and oval flints found by Dawson, in the Piltdown gravel, fashioned out of flint nodules split in two and flaked on one side only with *very coarse marginal retouch*, similar to that of Foxhall flints. Nos. 1, 1a, 1b, 1c and 2, 2a, 2b are nearly one half actual size; Nos. 3, 3a, 3b nearly one quarter actual size. Reproduced after Dawson. After Osborn, *Men of the Old Stone Age*, Fig. 60

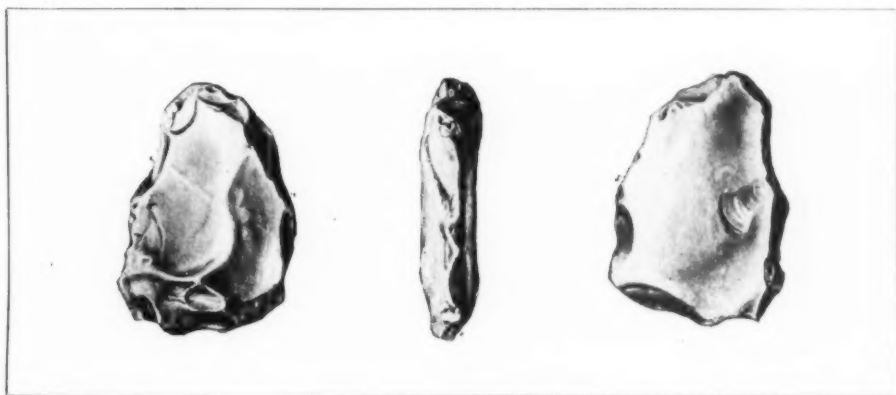


Fig. 13. A single worked flint of very primitive type found by Dawson in the same layer with the original parietal and frontal fragments of the Piltdown skull. Reproduced after Dawson. After Osborn, *Men of the Old Stone Age*, Fig. 65

today and surpassing that of the Australians, which rarely exceeds 1310 cubic centimeters in the male and 1154 cubic centimeters in the female.

1914

J. H. McGregor reconstructed the skull with a cranial capacity of 1300 cubic centimeters, a figure exactly similar to that arrived at by Elliot Smith and Smith Woodward.

Although we await a memoir on the characters of the Piltdown brain by Dr.



Fig. 14. The second and most recent restoration of the Piltdown skull by Dr. Smith Woodward, in which the nasal bones appear in place and the canine is inserted in the right half of the lower jaw, the position to which Dr. Gregory is inclined to assign it. One fifth natural size

Elliot Smith, the greatest British authority on the primitive brain of man, it is not probable that the final estimates of the brain weight will be materially altered, nor may we expect in the near future any great additions to our knowledge of either the skull or the teeth of the 'dawn man.' Inasmuch as a century of exploration in what may be called the pre-burial period of man has yielded the remains of only five individual specimens nearly or remotely related to man, the probability of finding additional fossils is rather remote. This greatly intensifies the interest of the important discovery of the Foxhall

man described in the preceding article and renders the more pressing the location of the lost jaw which is attributed to the Foxhallian stage of industry.

IS THE PILTDOWN INDUSTRY RELATED TO THAT OF FOXHALL?

The first archaeologist to make this suggestion was J. Reid Moir in his extremely interesting memoir, *Pre-Palaeolithic Man*, published in 1920,¹ wherein he remarks: "If the author, as a practical flaker of flint, had been shown Dr. Smith Woodward's reconstruction of the Piltdown skull and jaw, and had been asked what sort of flint implements in his opinion such a very primitive semi-human creature would be capable of producing, his answer would have been 'the very primitive edge-trimmed flints generally known as eoliths.' . . . The ill-defined cones of percussion, and rough, heavily-truncated flake-scars of the Piltdown specimens stamp them indelibly as the work of pre-palaeolithic man. . . . For the only implements found in the 'human' stratum and in intimate association with the Piltdown individual were the primitive edge-trimmed flints generally described as eoliths. . . . This particular type of implement represents, as has been shown in a former chapter, the earliest efforts of man to deliberately shape flints to his needs." He further points out that there would not appear to be any valid geological reason why the lower stratum of the gravel at Piltdown should not be a Pliocene deposit overlain by gravelly strata of more recent date, inasmuch as the Piltdown bones were found at about 120 feet above the present sea level and approximately 80 feet above the present level of the River Ouse, Sussex.

To test this significant statement, let us place side by side the published figures of the four flints actually found in the Piltdown gravels which hitherto have

¹Moir, J. Reid. *Pre-Palaeolithic Man*, 1920, pp. 1-67. Pls. I-XXIX.



Fig. 15. A—View of Piltdown Common showing at the right the hedge, at the side of which is the Piltdown gravel pit where the Piltdown skull was discovered. B—Roadway leading to Manor House, beside which the discovery was made. C—Manor House, at the end of the gravel road, the owner of which is deeply interested in further explorations beneath the roadway. D—Arthur Smith Woodward (right) and the present writer (left) standing on the heap of Piltdown gravel immediately above the spot where the skull was found. At this point it is proposed to erect a monument in memory of Piltdown Man

been broadly described as of pre-Chellean type (that is, earliest Chellean type), and four flints selected from those recently figured by Moir in his Foxhall collection, and see how they compare in the state of workmanship which they represent. In the writer's opinion, which is not that of a professional archæologist, the resemblance is very close indeed. It will be observed, even by the amateur, that both the Piltdown and the Foxhall flint implements are (1) fashioned from large flakes struck off from the side of the flint nodule, (2) that the outer or convex side of the flake is roughly worked with a varying number of blows, and (3) that there are a few solid core implements.

The five-fold *purpose* of the industry

in the Foxhall mind seems to have been (as shown in the foregoing article page 572): First, to fashion pointed flake implements, which could be fastened to wood and used in the chase, for example, rough spearheads (page 572, numbers 12-19); second, somewhat larger pointed core implements, which could be used in the chase or in combat—crude anticipations of the *coup de poing* (page 572, numbers 13-45); third, flaked implements dressed on one side, with cutting edges, which could be used in bone or wood carving; fourth, oval convex implements suggesting the rostracinate as well as *grattoirs*, flat on one side, which could be used in the dressing of hides for clothing (page 572, number 17); fifth, a borer (page 572, number 21) for use

in making holes in wood or bone. Hammer-stones used in the flint-flaking industry have been found at Piltdown only. All five of these types have been found at Foxhall, but only *three* in Piltdown, namely, the rough spearhead, the hide-dresser, and the hammer-stone. The *coup de poing* of pre-Chellean and Chellean times, namely, the 'hand stone,' fashioned from the flint nodule core itself, is foreshadowed in the Foxhall cores (page 572). Thus Moir's contention that the Foxhall Pliocene industry is prophetic of the Pleistocene industry of much more recent Chellean times appears to be well sustained. It follows that the identification of the Piltdown flints with the Foxhall flints, if it can be made by placing the implements side by side, may enable us to settle one of the remaining points of doubt about the 'dawn man,' namely, his geologic antiquity. Anatomists now agree that *Eoanthropus* is of a very ancient type, altogether such as we should expect to find at the very beginning of the Quaternary age of man or even in the Tertiary. The present writer came to the following conclusion in 1914¹: "It seems reasonable, therefore, to interpret the Piltdown skull as

exhibiting a closer resemblance to the skulls of our human ancestors in mid-Tertiary times than any fossil skull hitherto found." It was only the Piltdown flints, at that time mistakenly compared with those of pre-Chellean time, which led the writer to believe that the Piltdown man belonged in the Middle Quaternary, an opinion which he is now prepared to abandon.

In conclusion, the writer desires not only to recant his former doubts as to the association of the jaw with the skull, but to express his admiration of the great achievement of his life-long friend, Arthur Smith Woodward, in making the discovery and in finally establishing beyond question the authenticity of the 'Dawn Man' of Piltdown. We have to be reminded over and over again that Nature is full of paradoxes and that the order of the universe is not the human order: that we should always expect the unexpected and be prepared to discover new paradoxes. The confirmation of the reality of the Piltdown man as a veritable 'dawn man' must be followed by renewed and determined effort to fix more precisely his *geologic antiquity*, about which there has also been a great difference of opinion and on which the discovery of Foxhall man, described in the preceding article of this series, may have some bearing.

¹Osborn, H. F. *Men of the Old Stone Age, Their Environment, Life, and Art*. New York, Scribner's, 8vo., Nov. 24, 1915, 545 pp., Pls. I-VIII, 268 text figs. Third Edition, 1918, pp. i-xxviii, 1-559, Pls. I-VIII, Figs. 1-275, map.

DID THE INDIAN KNOW THE MASTODON?

AN ACCOUNT OF THE DISCOVERY IN MISSOURI OF A BONE BEARING AN
INCISED ELEPHANT-LIKE FIGURE

BY

JAY L. B. TAYLOR

Mr. Jay L. B. Taylor, a civil engineer of Pineville, Missouri, recently announced in *Science* the discovery of a number of decorated bones in a rock shelter, known locally as Jacobs' Cavern, situated on land that Mr. Taylor acquired not long ago in the extreme southwestern part of the state. One of these pieces of worked bone is of unusual interest because, as shown in the photographs accompanying this article, it bears a figure resembling a mastodon or a mammoth. In order to make this discovery known, Mr. Taylor has contributed the following brief narrative of his find. Last August, Dr. Clark Wissler, curator of the department of anthropology of the American Museum, visited Mr. Taylor and examined his collection and the cavern from which it came. At Mr. Taylor's request he has commented upon the cavern and the significance of the find.

Although the bone bearing what is presumably a mastodon or mammoth was found in April, 1921, the cavern containing it has been a site of interest to anthropologists for nearly two decades. In 1903 this cavern, which is only one of many rock shelters in the Ozark Mountains offering traces of prehistoric man, was excavated in part by Dr. Charles Peabody and Mr. Warren K. Moorehead of Phillips Academy, Andover, Massachusetts, who thereby directed attention to the archaeological treasures of this region. In this excavation Mr. Taylor, then a young man, assisted and thus laid the foundations of an interest in prehistoric archaeology that was later strengthened by the studies he pursued at Phillips Academy and that has been turned to such fortunate account in connection with the find below recorded. The photographs accompanying this article, as distinguished from the line cuts, were supplied through the courtesy of Dr. V. C. Allison.

LAST October the writer published in *Science* a brief notice of the discovery of engraved bones in the Ozark country near Pineville, Missouri. This announcement has brought many inquiries from interested readers, which I have thought could best be answered by a statement of the circumstances and conditions attending the discovery and by the reproduction of photographs and drawings showing the nature of the finds.

The discoveries were made in conjunction with my friend, Mr. Vance Randolph. Shortly after he became a resident of Pineville, I found that we had a common interest in prehistoric remains and I accordingly invited him to call at my ranch and examine Jacobs' Cavern and the collection I had taken out of it. On April 17, 1921, he visited me for the purpose and after he had inspected my collection, I took him down to the cavern. As we had in mind only a vague plan of casual and general inspection, with no intention whatever of conducting an extended exploration, we carried no digging implements. Upon entering the cavern Randolph's attention was im-

mediately attracted by the numerous bone fragments strewn over the floor and we spent considerable time passing our fingers through the *débris*, bringing to the surface other bone fragments and occasional flint chips, and in discussing such points of interest as occurred to us. Thus it was that prodding around in the floor at random, we at last proceeded to examine a heap of *débris* at the rear of the cavern. [The reader is referred to the diagram accompanying this article. The region examined is below the upward-extending, finger-like fissure].

The dirt, ashes, and small stones here deposited in considerable quantity had originally reposed beneath the overhang of the rear wall of the cavern [the section on the diagram that resembles somewhat a bent thumb thrust into the solid area.] This *débris* had only recently been thrown out—some of it by hunters, tourists, and the like, I suppose, who dug through mere curiosity, and some by myself in an unsuccessful attempt to reach the extremity of the overhang. Flung out at random, this *débris* had piled up until it covered the stump of a stalagmite, the top of which had been

shot off with dynamite—an operation that had been performed without my knowledge or consent.

lated stalagmite as No. 4 on the above mentioned map.

An extremely wet season last spring

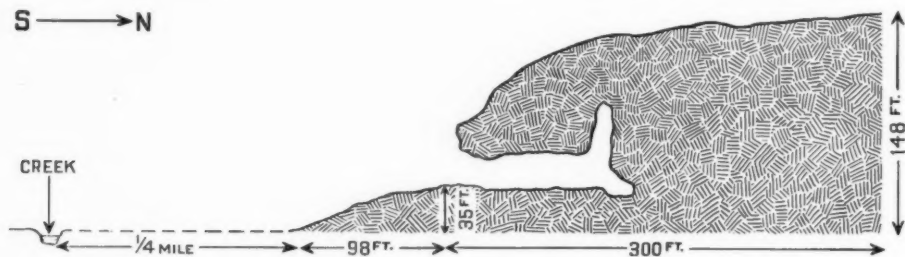


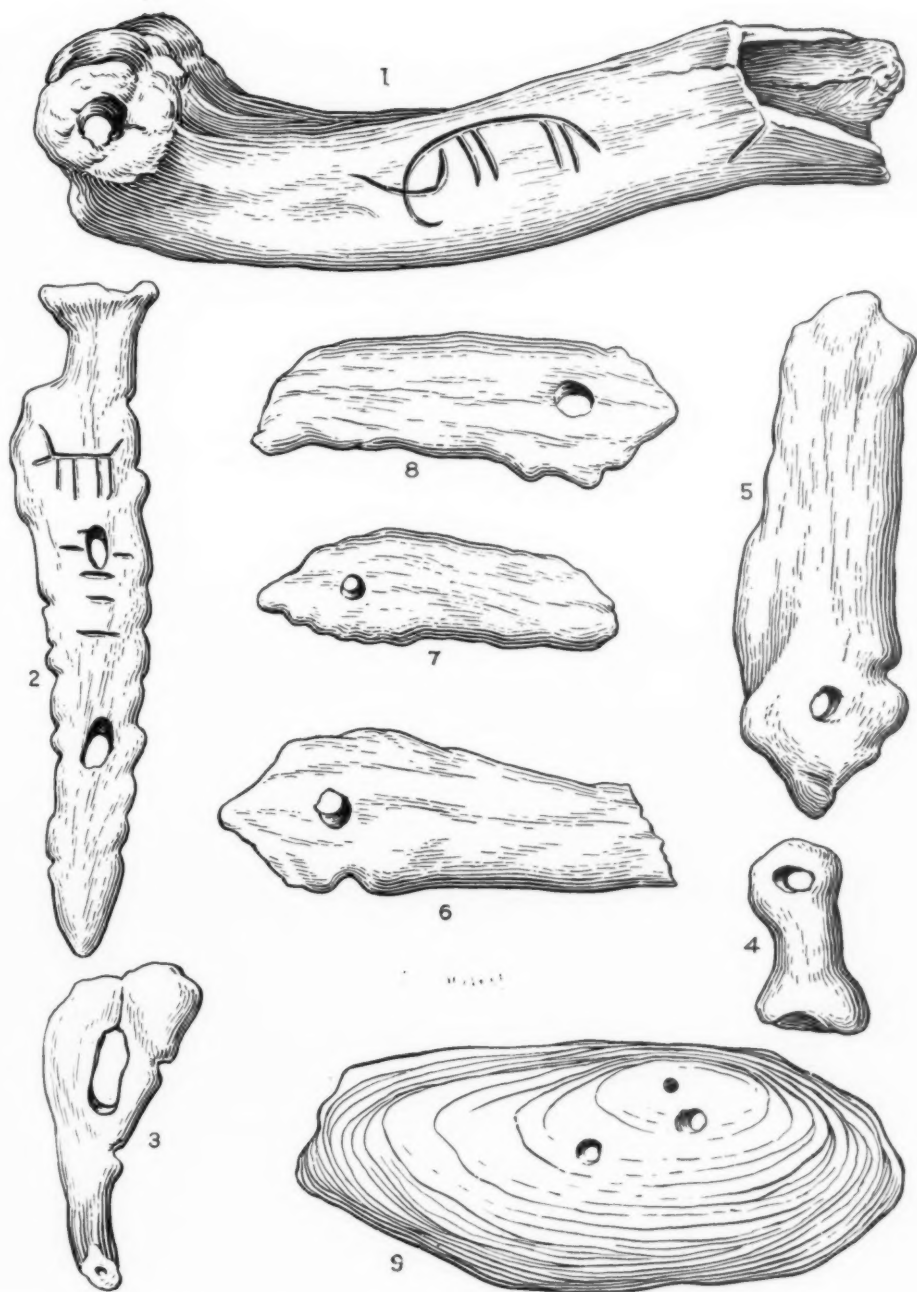
Diagram of Jacobs' Cavern

In the absence of markings established in the exploration of the cavern in 1903, I rely wholly upon my memory of that exploration, in which I participated, and upon my familiarity with the cavern and with the map shown in Bulletin No. 1, "Exploration of Jacobs' Cavern," Department of Archaeology, Phillips Academy, Andover, Massachusetts, 1904, by Charles Peabody and Warren K. Moorehead, when I identify this muti-

resulted in the precipitation of considerable moisture through the fissure. In fact, on the day when Randolph and I were making our investigations there was a miniature stream of water dripping from the stalactite which hung directly over the stalagmite stump, while from other points along either side of the fissure other small streams dripped or trickled down upon the accumulation which had come from beneath the



A glimpse of the interior of Jacobs' Cavern.—The stalagmite stump, from the pothole of which engraved bones were recovered, is not shown but lies directly back, and to the right, of the large light-colored stone on the extreme right of the picture. This stone is itself one of the fragments of the dynamited stalagmite. The large stone, in a corresponding position on the left of the picture, is a slab that has fallen from the roof of the cave. To the left of this slab, in an area not visible in the picture, was sunk the shaft to which Dr. Clark Wissler makes reference in his letter at the close of the article



OBJECTS OF HUMAN WORKMANSHIP FOUND IN JACOBS' CAVERN

These line drawings were made by Mr. Vance Randolph, the co-discoverer, on the evening of the day that the objects were unearthed. This pictorial record is a valuable piece of evidence, for disintegration of the bones speedily set in and ultimately all were thus destroyed except the topmost bone, which, however, is most prized of all, for this is the bone that bears upon it the engraved elephant-like figure



On the walls of some of the European caverns, like that of Combarelles and of Font-de-Gaume, are representations of mammoths, proving that these creatures were known to early man in the Old World. What seems to be evidence that in the New World, too, early man knew the mammoth or the mastodon is furnished by the incised figure on the recently unearthed bone represented above

over-hang, until in most places there was more or less mud and muck. Having finished groping around in this mud, I turned to wash my hands in the stream of water falling toward the stalagmite. The volume of water was, however, insufficient to remove the mud and I started, accordingly, to scoop out a small basin that would impound enough water for my use. But in doing this I uncovered the calcaneum bone [represented by Fig. 5, p. 593] of a ruminant, and having casually wiped away the mud, as we had been doing with the bones taken from the muddy area, I was surprised to find that the lower end had been perforated. Having assured myself that the perforation was apparently of human origin, I called Randolph's attention to it and to the fact that I had never before found such a specimen in the cavern. Digging farther we found that the top of the stalagmite had been shot out in the form of a pothole of possibly two gallons' capacity, and from the mud and water in this we soon took three other perforated calcanea, a perforated and notched spinous process of a dorsal vertebra, a perforated metatarsus, a portion of a perforated and engraved humerus (bearing the "mastodon"), of ruminants; a small slotted and notched scapula, evidently of a rodent. In addition

to these bones our collection included a mussel shell with two perforations.

Naturally our chief interest centered about the "mastodon," for we straightway concluded the carving was supposed to represent this creature, and after we had somewhat recovered from our excitement we took the bones down to the creek and gave them a thorough wash in clean water.

Every specimen was apparently sound and at that time there was not the least evidence, so far as we could ascertain, of disintegration. Feeling, however, that we had made a discovery of more than ordinary importance, and that the bone bearing the "mastodon" must necessarily be of great age, we discussed the advisability of making drawings and photographs of the specimens and finally concluded to adopt such measures in order to have a record of our findings in the event that they might through some unforeseen chance be lost or destroyed. Accordingly, late that same evening, Randolph made line drawings, natural size, of each piece. I regret that I neglected to have photographs made immediately but can excuse such neglect to a slight extent by explaining that further examination of the bones did not create in me much apprehension as to their condition.



Another view of the bone showing additional carvings. This bone was rescued from threatened disintegration by being boiled in hot paraffin. It was subsequently incased in a block of paraffin and kept thus until it could be inspected by Dr. Clark Wissler, of the American Museum. The finding of this bone should be a stimulus to further systematic investigation of the floor of Jacobs' Cavern

Subsequent desultory exploration failed to result in further similar discoveries if one except that of another perforated metatarsus, which I picked up a day or two later, probably some three feet from where the other bones had been found.

In the interim it had occurred to me that possibly I had been made the victim of a hoax. Amateur archæologists—professionals, too, for that matter—are regarded in this locality as legitimate prey upon whom to foist all sorts of fakes and “relics.” The bones were apparently as sound as could be when I placed them in my cabinet. This puzzled me because I knew that if a prehistoric artist had actually made the carvings with the idea in view of depicting a “mastodon,” at least that particular bone must necessarily be of great age and should, therefore, be quite fragile. Furthermore, as these bones had come from such a restricted area, having probably all been thrown out together from under the overhang, I was not long in concluding that they had probably at one time formed a necklace and were, therefore, practically of the same age.

Both Randolph and myself communicated with various institutions in attempts to secure professional opinions concerning our find. The officials of

several such institutions replied by suggesting that the bones be donated to their own museum and some requested permission to publish an account of the discovery. However, I declined all requests for permission to publish and insisted that nothing be given to the press at that time. I had no desire to be severely ridiculed if the “relics” proved to be fakes, nor did I wish to foist any frauds on the public. I felt, however, that the scientific world was entitled to a full account of the discovery in the event that competent authorities pronounced the handiwork as of genuine prehistoric origin, and I anxiously awaited the arrival of Doctor Wissler, who, I had been advised, would try to examine both the cavern and the bones about the middle of August.

Meanwhile, professional duties had prevented me from making frequent examination of my collection and when I did at last find time to re-inspect it, I was dumfounded to observe that disintegration was rapidly destroying my latest acquisitions. I immediately coated them with hard oil—the only thing at hand which in my opinion would exclude the air—but this failed to harden as it does on lumber, and disintegration progressed apparently unchecked. Having been advised by professional author-

ity to use hot paraffin, I telephoned Randolph to hurry out to the ranch and to bring with him some paraffin. That afternoon he gave the remaining bone a thorough boiling in that preservative. A short time afterward I encased the bone in a block of paraffin, where it remained until melted out for Doctor Wissler's inspection on August 18. When this bone was freed of its paraffin envelope, a few small fragments broke off around the perforation but in the main this bone appeared to be fairly well preserved.

Along with the bones the mussel shell also completely disintegrated, so that at this time, of the nine objects mentioned, only the perforated and engraved humerus remains.

My loss of these specimens was, however, compensated for in a manner by the relief I felt concerning the origin of the handiwork displayed on the humerus. It seemed, and so appears to me yet, that recent carving would be impossible on a bone so old that disintegration would result soon after exposure to the air. Personally I feel that up to this time developments justify my faith in the genuineness of the handiwork. However, I do not pretend to be more than the veriest amateur and if competent scientific examination disproves my conclusions, I shall be only too glad to admit my error in judgment.

In corroboration of the above I quote a statement prepared at my request by Mr. Vance Randolph in November, 1921, and mailed from the University of Kansas:

"On April 17, 1921, I was a guest at the Taylor ranch, and Mr. Taylor showed me the collection in his den. I expressed a desire to see the cavern itself, and we went down and began to scratch about with sticks along the northeast wall. Mr. Taylor soon dug up a mussel shell with two round holes in it, and a few minutes later, fumbling about in a little wet spot under a roof-drip, I unearthed a piece of bone about $4\frac{1}{2}$ inches long,

notched, pierced, engraved, and polished [represented by Fig. 2 p. 593.] Mr. Taylor then sat down beside me, and we clawed with our fingers in the ice-cold mud and water until we had altogether 8 pierced, polished bones, one of which bore the engraving which we thought resembled a mammoth or mastodon. These bits of bone were all found very close together (a 15-inch circle would have enclosed them all, I think) and between 4 and 12 inches below the surface. A few inches lower we struck a solid rock, which Mr. Taylor said was the stump of a stalagmite that had been blasted off some years before. We washed the specimens in a little creek, and that evening measured them and made several sketches of each.

"Some three weeks later Mr. Taylor told me that 7 of the bones had completely disintegrated, and that he had coated the one bearing the mastodon carving with varnish. On June 13, 1921, Mr. Taylor had the specimen photographed, and immediately afterward we boiled it for two hours in hard paraffin. Later on Mr. Taylor embedded it in a solid block of this material, in which it remained until Dr. Clark Wissler visited the cavern Aug. 17, 1921."

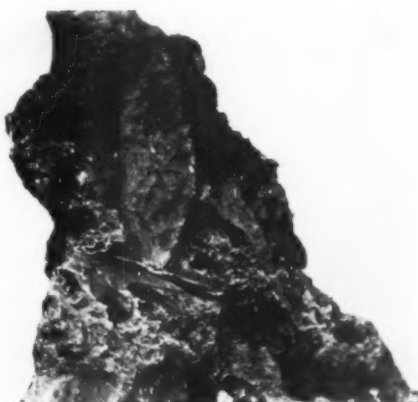
I have the privilege of submitting the following memorandum from Dr. Clark Wissler who visited the cavern in response to my invitation:

"The opportunity afforded me by your hospitality to examine the carved bone found by you and the privilege of exploring further in the cave, in the company of Mr. Randolph, Dr. Vernon C. Allison, and yourself, is greatly appreciated. Jacobs' Cavern has long been known to us through the report of Peabody and Moorehead and has frequently been cited as one of the possible type stations for early man in America. It is, therefore, of unusual interest to know that this site is by no means exhausted, but still rich in data. The question your find raises is whether the person who made the sketch on the bone that has been pre-

served saw a mastodon or mammoth. This cannot be answered positively, but the probabilities of the case can be estimated. In the first place, the work is of the primitive stamp and such as we might expect from the hand of an American native. It so happens that upon these bones at least three attempts were made to represent living forms, apparently by the same artist. Two of these forms have the distinctive lines of elk and deer, while the lines of the third characterize elephant kind. This favors the interpretation that an elephant, mastodon, or mammoth was intended.

"At once the objection will be raised that the bone is recent. Though the mastodon and the mammoth are characteristic of Pleistocene time, it is not known when they became extinct; for all that is known to the contrary, these great mammals may have held out to within three thousand years ago. Thus, the artist could have seen one of these animals and still have lived under modern conditions. No one in authority seems now prepared to deny that man was in America three thousand years ago. In other words, there is nothing zoölogical that makes your interpretation improbable. We must, therefore, turn to the cavern itself.

"It appears that this bone was found in the present surface of the cave, but approximately five feet of deposit were taken out by Moorehead in 1903; hence, this bone is older than anything found by him. When we recall that both Peabody and Moorehead were impressed with the great age of what they removed, the evidence is again favorable to your interpretation. Also, there are still in the cavern almost five feet of deposit, in the main clay, through which you were so kind as to sink a shaft in my presence. This excavation indicated the presence of man's handiwork in all parts of this deposit, one piece of worked stone being found at the very bottom of the shaft,



A fragment of the dynamited stalagmite found in the cavern with an implement of early man imbedded in it. From time to time stalagmites have in this way carried down to the present the records of the past. A stalagmite containing the preserved impressions of moths' wings was some months ago discovered in the Cheddar district in England. Each layer of the stalagmite showed a number of these fossils, and it has been assumed that the wings were rejected by bats while feeding upon the insects

lying flat upon the original stone floor of the cavern. One must conclude, therefore, that there are remains in the cavern that are of even greater age than the bone in question.

"In general, then, I regard this site as one of the most important yet discovered and one demanding further investigation. Regardless of what may ultimately prove to be the significance of this carved bone, you have made a discovery of great promise. I assure you of my appreciation of your confidence, in extending an invitation to make further excavations in this deposit and its surroundings.

"So, pending the examination of the site, as indicated above, no further comments seem necessary. The writer will do everything he can to further this investigation to the end that the complete story of Jacobs' Cavern may be revealed. It is to be hoped that at last we are on the trail of early man in America."

URUS AND BISON

BY

W. D. MATTHEW*

THE American Museum has recently acquired a fine skull and jaws of the urus, or extinct wild ox of Europe, and an incomplete fossil skull of the almost extinct European bison. These valuable fossils were obtained from the Cambridge Museum of Zoölogy in an exchange arranged through the good offices of the curator, Mr. C. Forster Cooper, who was one of Dr. William K. Gregory's palæontological students, and who since his return to England has been a very good friend of this Museum.

The remains of the gigantic wild oxen are not uncommon in Europe. The finest specimens have been found in England, in the draining of old marshes or fens, especially in the eastern counties, in clay pits and bogs, less often in caves. The skull acquired by the Museum is from Burwell Fen, near Cambridge. A fine series was found in the Ilford brick clays in Essex, of which the largest skull now in the British Museum, is 914 mm., or about three feet in length. Other fine skulls and skeletons have been found in Germany, the Netherlands, France, and Italy, as far north as Scandinavia, as far east as central Russia.¹

The name, *Bos primigenius*, was given to the fossil species of wild ox many years ago by Bojanus. This animal has been commonly regarded as a sub-

species or race of the domesticated cattle,* representing in a general way, at least, the primitive stock from which our domestic cattle are descended, and as being the urus or aurochs of Roman and mediæval writers. The earliest historical account of the urus is given by Cæsar in his *Commentaries on the Gallic War*. He found them, or more likely heard of them, in the great Hercynian forest, which in his day stretched from Switzerland to the east and north across central Europe. As Cæsar's account appears to be the basis of most of the later references to this animal, and as it is an interesting example of the natural history of his time, it is worth while to give a translation of the entire passage,² which reads as follows:

"This Hercynian forest, mentioned above, extends for a width of nine days' journey made with light equipment, for in no other way is it possible to reach the end of it or to know the distance traveled. It begins at the territory of the Helvetii, Nemeti, and Rauraci, and stretches along the Danube valley to the country of the Dacians and Anarti; thence it swings to the left away from the river country and on account of its vastness reaches to the confines of many nations; nor is there anyone in this part of Germany who claims either to have attained the borders of this forest even in a sixty days' journey, or knows where it ends. Many kinds of wild beasts exist in it which are not seen elsewhere; among which those that differ most from others and appear most worthy of note are the following:

"There is an animal that looks like a deer, and bears a single horn on the middle of its forehead, between the ears, longer and straighter than the horns which we know. From the top of this horn branches like palm leaves spread out widely. The male and female

²*Commentaries on the Gallic War*. Book VI, chapters 25-28.

¹NEHRING. 1896. *Landwirtsch. Jahrbuch*, Vol. XXV, p. 915 (1896).
WILCKENS. 1885. "Die Rinder des Diluviums und der Pfahlbauten." *Biol. Centralbl.* V. 79-95, 109-123.
LYDEKKER. 1898. *Wild Oxen, Sheep and Goats of All Lands*.
LYDEKKER. 1903. *Mostly Mammals*.
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are alike in appearance and have the same size of horns.

"There are also what are called Alces. These are very much like goats as to their form and their dappled skin; but they are somewhat larger, have no horns, and their legs have no knuckles or joints; they neither lie down to sleep nor, if by accident they fall down, can they arise and get on their feet again. They use trees for their resting place; against these they lean, and thus reclining only a little they take their sleep. When the hunters discover from the tracks the places where they are thus accustomed to rest, they either loosen all the trees at that place about the roots, or cut the trunks nearly through and leave them standing. When the animals come according to their custom to take their rest, their weight topples over the weakened trees, and they fall down along with them.

"The third of these animals is the kind that is called urus. These are in size a little less than elephants, in appearance and color and form they are bulls. Great is their strength and great their swiftness; they spare [refrain from attacking] neither man nor beast whom they have perceived. These they [the Germans] take pains to catch in pits and kill. With such labors they harden their young men, and exercise them in this kind of hunting; and he who has killed the largest number, the horns being exhibited as proof, receives great praise. But they are unable to tame them for domestic use, even when caught young. The horns differ widely in size, form, and appearance from those of our domestic cattle. They are diligently sought after, ornamented with silver bands around the rims, and used for cups at their most magnificent banquets."

Cuvier¹ identified the first of these three animals as the reindeer. Possibly it was; but if so, Cæsar must have misunderstood the accounts given him of its characters; and it can hardly be taken any more seriously than the unicorn or the lamia. The second animal, which he calls Alces, is usually regarded as the elk; but except for the name the

description is quite at variance with the real European moose or elk.¹ It is quite likely indeed that Cæsar's account is the real source of the mediæval tradition that the elk had no joints in the legs. Pliny repeats it, along with some other even more impossible stories,—that it was so swift that it could not be caught except in the manner recited; and that its nose was so long that it had to run backward all the time for fear of breaking it off against the trees,—and it seems much more likely that the jointless leg story was handed down via classical and monkish tradition in writing than that it came through early Teutonic folklore channels.

The third animal, the urus, has much more appearance of authenticity. If it was, as generally supposed, the same as the prehistoric *Bos primigenius*, its size is considerably exaggerated. Cæsar had perhaps seen the gigantic horns, and from that judged of the size of the animal. Whether the name urus was a Latinized form of an old Teutonic name, *auer-ochs* or *ur-ochs*, which survived also and independently in Teutonic speech and tradition until we pick it up again a dozen centuries later in mediæval records, or whether the mediæval aurochs is not rather a Germanized form of the Latin name for the beast, handed down not through Teutonic but through classical and monkish tradition, is not easy to decide. The later accounts, both Roman and mediæval, are obviously borrowed in part, if not wholly, from Cæsar's statements. It is said by some classic writers² that the animal was exhibited in combats of wild beasts in the Roman arena; but if so, it is singular that those who have recorded

¹It is, in fact, nothing more than another "fabulous monster," as Alice would call it. The explanations current, that "Cæsar saw only the female" and that "the length and awkwardness of the elk's legs suggested their having no joints," are quite unable to make real natural history out of the account. Cæsar did not profess to have seen the animal, but his informants did profess to be familiar with it. And while the moose has long legs and some awkwardness of gait, it does not look in the least as though the legs had no joints. I may add that the story is found in much older Greek authors, and if I remember rightly, taken by them from Persian sources.

²Pliny, *Natural History*.

¹*Ossements Fossiles*, 3e Ed., t. IV, p. 57.

the fact had no further knowledge of the animal than they would have obtained from Cæsar's *Commentaries*. The statement may be explained by the fact that in later classical and mediæval times the urus was confused with the European bison and with the "bubalus," properly speaking the Indian buffalo, but also applied to a large African antelope. In the *Nibelungenlied* we hear of the hero Siegfried slaying the urus in a great hunt at Worms:

Darnach schluch er schiere einen Wisent und
einen Elch
Starker Ure vier und einen grimmen Schelch.

Here again the name follows closely the term used by Cæsar, and since the animal is not mentioned (so far as I know) in the older and more authentic Scandinavian sagas, where, if surviving in Germany at this time, it should surely have also found place and mention, one may suspect that the urus has slipped into the *Nibelungenlied* along with various other fragments of classical tradition which the poem embodies. Without going into any detailed, critical examination of the "historic" records of its survival, we may conclude provisionally that Cæsar's account is the only classical one that need be taken seriously. While the other animals that he associates with it must be dismissed as mythical, the description of the urus was apparently based upon some real knowledge of the animal, probably of the gigantic horns. These might well account for his exaggeration of the size of the creature itself. The skulls in some British examples of the *Bos primigenius* are nearly three feet long and the horn cores not only long but exceedingly massive, with a peculiar curvature, outward, upward and inward, unlike the comparatively slender, spirally-twisted, out-pointed horns of the modern long-horned Spanish breeds from which our Texas long-horns are derived. The fossil skeletons, however, are not so gigantic as one would suppose from the size of

the skulls and horns. They are not much if at all larger than some large, modern domestic breeds.

Cæsar's account has been confirmed in an interesting way by the excavation a few years ago in Swabia of two statuettes of Roman age, representing the bison and the urus respectively.¹ So at least Lydekker reports; but an examination of Fraas's paper shows that there was no real evidence either of the Roman age of these statuettes, or that the one identified as aurochs (urus) really represents that animal rather than the domestic species.

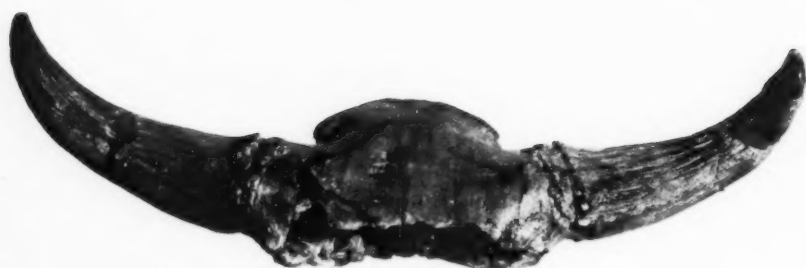
If the urus survived in the German forests to the time of Cæsar, there is no inherent improbability in its surviving ten or fifteen centuries later. The later classical and mediæval references to it can hardly be cited, however, as conclusive proof that it did so. Some are mere references by name, and have no more significance than some modern poet's mention of mermaids or fairies. Such references do not mean that the writer actually believes in their existence, still less that he has seen them or knows of their existence. It is ridiculous to cite such casual allusions as scientific evidence of the survival of the urus at the time of the writer. Other notices show internal evidence of being merely based upon Cæsar's description. They convey the same items of information about the urus—no more—and are couched mostly in the same words and phrases. Such precise agreement is like the unduly close agreement of the testimony of two witnesses in a case at law. It does not serve to confirm the truth of their story but indicates that it is not independent witness, the stories having been agreed upon in advance, or one copied from the other. Mediæval records, it must be remembered, were written mostly by monkish writers, or by those who had been educated in the convents. All these writers, religious or secular, were more or less familiar

¹Fraas, 1899. *Fundberichte aus Schwaben*.



THE URUS OR EXTINCT WILD OX CONTRASTED WITH THE MODERN COW

The urus or aurochs (the upper skull) was undoubtedly hunted by prehistoric man in Europe, stone weapons having been found imbedded in, or associated with, fossil skeletons of this animal. It may even have survived into historic times, for it is mentioned by Cæsar in his *Commentaries on the Gallic War*, and with more evidence of authenticity than is shown in his fantastic descriptions of certain other wild animals. The skull of the urus above depicted, now on exhibition on the fourth floor of the American Museum, presents a more massive appearance than that of the domestic cow, reproduced below it, but it is an exaggeration to assume, as does Cæsar, that in size these extinct oxen were "a little less than elephants"



THE EXTINCT EUROPEAN BISON COMPARED WITH THE MODERN AMERICAN BISON

Compared with the extinct *Bison priscus* of Europe—an incomplete skull of which, recently acquired by the American Museum, is shown in the upper part of this plate—the modern American bison (represented by the lower skull) is a degenerate creature. The skull of the extinct European bison was taken from the older Pleistocene gravels of Great Barrington, near Cambridge. At that period of geologic time, hippopotami, straight-tusked elephants, and other species of a warm, temperate climate ranged far to the northward through England, France, and Germany. Notwithstanding the impressive spread of horns in this extinct European bison, the finest development is reached in the species from the Pleistocene of North America.

with the Latin language and literature, and inherited the classical traditions. Most of their natural history was learned from Pliny, who in this instance copied from Cæsar. Their references to the urus and bison, or ur-ochs and wisent as they would Germanize the words, may well have been based upon that Roman tradition, with respect to the facts as well as the words, rather than upon any real contemporary evidence. This is so obviously true with respect to many other matters that they have put upon record, that one may be excused for declining to class such "records" with the unmistakable facts of actual specimens.

There is one mediæval record which is really authentic, eye-witness testimony. Baron Herberstein in 1550 published a book on his travels in Muscovy, in which he describes and figures a race of wild cattle, which he calls the aurochs or urus, as existing in the great forests of Poland. He obtained and brought home specimens, and there is no question that his description and figure refer not to the bison but to a race of wild cattle. If the animal he describes is identical with the fossil *Bos primigenius*, as is believed by Nehring, Lydekker, and other authorities, it would finally settle the question of survival. Herberstein's figure, however, is not characteristic. It might represent a small-horned and small-headed *primigenius*—and many such specimens have been found in eastern Germany and Russia, where the prehistoric race did not attain such magnificent proportions as it did in England; or it might represent a feral race of cattle, like the wild cattle preserved in certain English parks. The color of Herberstein's aurochs was black; the park cattle, still existing at Chillingham, Chartley, Lyme, and one or two other localities in Great Britain, were white. Although they were generally regarded a century ago as being descendants of the urus, it has been shown that this is impossible, because in the first place they

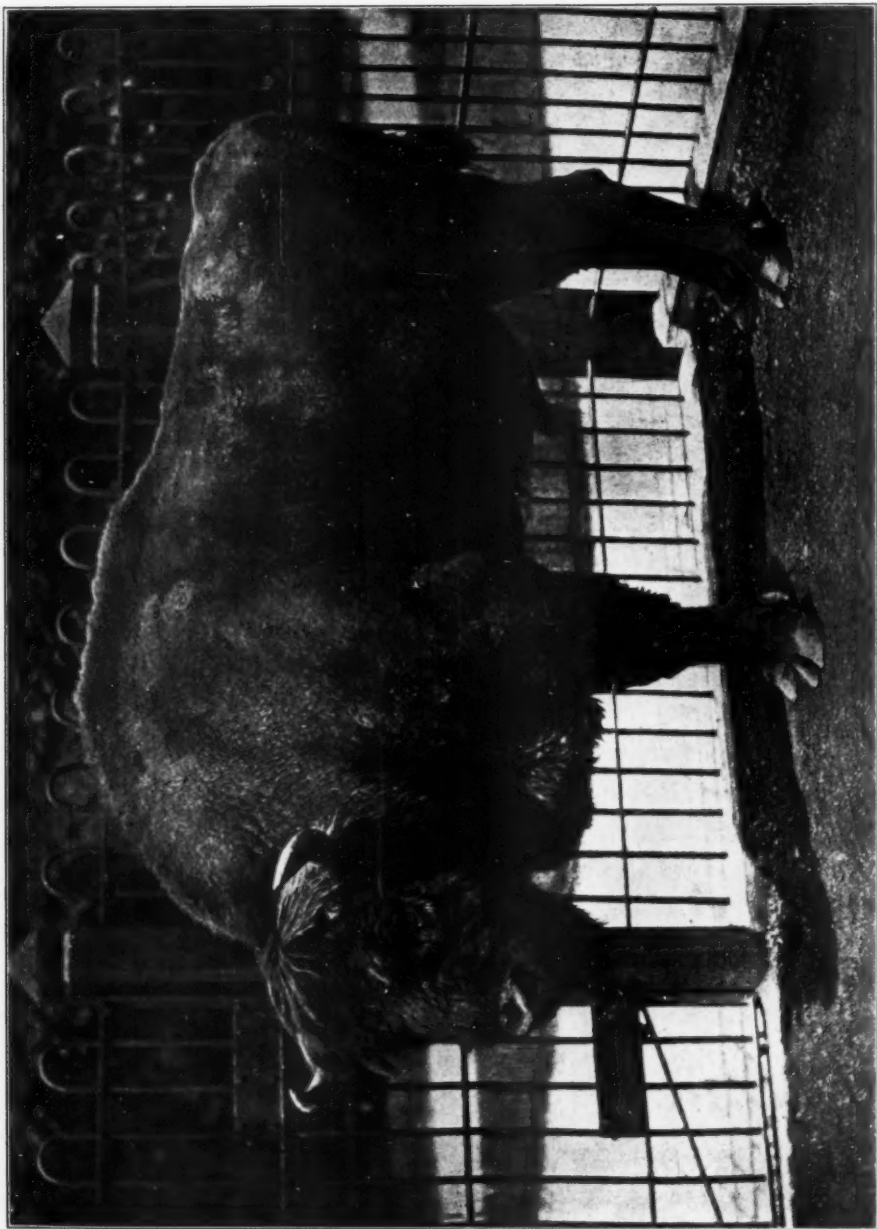
are an albino race and in the second place there is pretty clear evidence that the aurochs had become totally extinct in England before Roman times, and finally they have no characteristic resemblance to the prehistoric *Bos primigenius*.

Of actual relics or specimens showing the survival of the urus into the historic period there appear to be very few if any. Buffon describes two aurochs horns as preserved in his time, one at Strassburg, the other at Saverne in Alsace. The first, because of its slenderness and spiral curve and for other reasons Nehring dismisses as probably the domestic species; the second he thinks probably really was *primigenius*; but both have disappeared since the French Revolution; and a pair of horns, traditionally of the urus, which used to be carried in processions in the canton of Uri, Switzerland, have also disappeared. In fact, there is not, according to Lydekker, a single authentic relic today of an aurochs killed within the historic period.¹

The numerous Roman remains in Great Britain have been carefully studied, and no trace of the urus is found among the animals recorded therein. It must, therefore, have been extinct or practically so within the areas of Roman occupation, although it is abundantly found in the preceding prehistoric stages. In Scandinavia it is found abundantly with the Stone Age remains, but is absent in the succeeding Bronze, Iron, and Mediæval stages of culture. In Germany and France it is in general also confined to the Stone Age remains, but there is at least one specimen, a skull described by Nehring from Bromberg, which probably dates as late as early Mediæval time, and if correctly identified as *Bos primigenius*, would prove the late survival of this species. Here also there is considerable doubt as to the identification.

There is no question that the wild ox was hunted by prehistoric man. A skull from Burwell Fen has a stone weap-

¹Lydekker, 1903. *Mostly Mammals*, p. 295.



MODERN EUROPEAN BISON

One of the probable victims of the Great War and its aftermath—a victim whose extinction has been heralded so little that there is still a lingering doubt as to its actual accomplishment,—is the European bison, which, at least up to the time of the war, had survived in the forests of Lithuania and the Caucasus. If the reports of its extinction in the wild state are well founded, the only living representatives of this animal are the few that are caged in zoological gardens. The fine picture shown above is one of many impressive photographs of animals contributed by Mr. Gambier Bolton, F. Z. S., to a volume entitled *All About Animals*, for Old and Young, published by George Newnes, Ltd., of London

on buried in its forehead; a skeleton from Vig in Denmark has both fresh and old wound-scars on the ribs and with it were found three stone spear-points; these are but two out of many instances of this kind. While thus abundant in the earlier and later Stone ages, it seems to have disappeared before the spread of civilization, surviving as a wild animal only in the great forests of central Europe.

If, as Nehring, Lydekker, and other authorities maintain,¹ this species was really the ancestor of our domestic cattle, it has of course survived in a reduced and degenerate form. If, on the other hand, the successive races that have invaded western Europe brought with them their own domestic animals, instead of attempting to tame the wild cattle that they found inhabiting the country,² we may better regard the urus of western Europe as an extinct species, or race of *Bos primigenius*, that reached its finest development in western Europe in prehistoric times, and became extinct without affecting to any great degree the blood of the domestic races of cattle, which would be derived from distinct geographic races or subspecies inhabiting eastern Europe or Asia. In this respect it would parallel, as Owen has observed, the bison of America, which has disappeared before the white invaders without being to any extent domesticated or influencing the blood of the domestic cattle that they brought with them. Owen's view seems to me far more probable. The invading tribes from Neolithic times onward certainly had domesticated cattle, and it would be much simpler and easier to bring them along than to undertake over again the processes of taming and selective breeding from wild races.

Against this view that the prehistoric invaders of Europe brought with them

their domestic cattle from their original eastern homes, it has been objected that there are no true taurine wild cattle in Asia, the wild races being all of the bibovine or zebu group. This is true today, but it is significant that in the Pleistocene of India has been found a fossil species of this taurine group, *Bos namadicus*, closely allied to the urus and our domestic cattle. This fact indicates that the taurine group did inhabit Asia in the Pleistocene and there seems to be every probability that domestic cattle are derived from it rather than from the wild aurochs of western Europe. The latter, then, would be a wild species or race that reached its finest development in prehistoric times, in Great Britain, France, and Germany, survived probably to Roman and possibly to Mediæval times in the forests of central Europe, but is now wholly extinct.

The incomplete skull of an extinct European bison obtained from the Cambridge Museum and alluded to at the beginning of this article, has the horn cores nearly perfect and finely preserved. This specimen is from the older Pleistocene gravels of Great Barrington, near Cambridge. Unlike the urus, the European bison still exists, in a wild or half wild state in the Caucasus,¹ and in various private or public parks and zoological gardens; but the modern species is a degenerate descendant of the great *Bison priscus* of the Pleistocene. It is a near relative of the American bison, somewhat less striking and peculiar in its characters, and like the urus it was common throughout Europe in prehistoric times. This is the bison of the Romans, the wisent of early Mediæval times; and it appears that after the disappearance of the true urus, the name of aurochs (aurochs = ? ur-ochs) was transferred to the bison, which is very commonly but mistakenly called by that name.

While the true wild cattle reached

¹Nehring, 1896.
Lydekker, 1898. *Wild Oxen, Sheep and Goats of All Lands*, pp. 15-18.

²Owen, 1846. *A History of British Fossil Mammals*, pp. 491-515.

Duerst, 1904. *Archiv. f. Anthropologie*.

¹That is to say, it was existing in the Caucasus before the Great War. It is reported that all the Russian bison have been killed off since the war.

their finest development in western Europe in the magnificent *urus* and never reached the New World, the largest and finest bisons are the species from the Pleistocene of North America, es-

pecially the great *Bison regius*, whose head is in the American Museum collection and whose splendid proportions are depicted by Mr. Knight in the mural painting in the Hall of the Age of Man.



The skull of *Bison regius*, the great, long-horned bison of the Pleistocene of North America, which is shown in the upper part of this plate, is believed to be the largest and most complete skull of this animal that has ever been found. It is exhibited on the fourth floor of the American Museum. The spread of the horn cores, from tip to tip, is 5 feet, 10 inches. By way of contrast there is reproduced in the lower part of the plate the skull of the existing American bison. The *Bison regius* inhabited the United States during later Pleistocene time, along with the mammoth, the mastodon, and the great ground sloths

RAINS OF FISHES

BY

E. W. GUDGER*

DO FISHES fall in rain from the sky? To this question both the layman and the scientist are well-nigh unanimous in giving a negative answer. Recently a level-headed business man and experienced angler grew almost indignant at being asked such an absurd question, and at least one scientific man of my acquaintance has expressed himself equally strongly.

My attention was first called to this subject about eleven years ago on reading De Kay's account quoted on p. 612 of this article. It was again forcibly called thereto on my perusing McAtee's excellent article (p. 617), in which a considerable number of falls of fishes is recorded. And lastly, my work during the last two and a half years as associate editor with Dr. Bashford Dean of Volume III of the *Bibliography of Fishes*, now being brought out by the American Museum of Natural History, has, with the completion of the latter part of the synoptic index, brought to my hand all the known literature on the subject. This is herein set forth in the form of chronological excerpts, that the reader may have the evidence before him.

THE ACCOUNTS

Our first and oldest account of a rain of fishes is found in *The Deipnosophists or Banquet of the Learned* of Athenæus of Naucratis in Egypt, who flourished at the end of the second and the beginning of the third centuries, A. D. This learned work, first published in 1524, is a compilation of extracts from more than eight hundred classical authors, most of whose works are no longer extant and would be forever lost but for the book of the Deipnosophists. It is written in the form of a dialogue, and in Volume II of Yonge's translation,

in a chapter entitled "De pluvîa piscium," we read on p. 226:

"I know also that it has rained fishes. At all events Phœnias, in the second book of his *Eresian Magistrates*, says that in the Chersonesus it once rained fishes uninterruptedly for three days, and Phylarchus, in his fourth book, says the people had often seen it raining fish."

The next account is contained in a letter from Robert Conny published in the *Philosophical Transactions of the Royal Society of London* in 1698. Conny did not see the phenomenon nor specimens of the fishes, but had his account from a person who seems to have had his confidence. The account in question is as follows:

"On Wednesday before Easter, Anno 1666, a pasture field at Cranstead near Wrotham in Kent, about two acres, which is far from any part of the sea or branch of it, and a place where are no fish ponds, but a scarcity of water, was all overspread with little fishes, conceived to be rained down, there having been at that time a great tempest of thunder and rain; the fishes were about the length of a man's little finger, and judged by all that saw them to be whittings, many of them were taken up and shewed to several persons; the field belonged to one Ware a Yeoman, who was at that Easter-Sessions one of the Grand Inquest, and carried some of them to the Sessions at Maidstone in Kent, and he shewed them, among others, to Mr. Lake, a bencher of the Middle Temple, who had one of them and brought it to London, the truth of it was averred by many that saw the fishes lie scattered all over that field, and none in other the fields thereto adjoining: The quantity of them was estimated to be about a bushel, being all together."

In Volume V of Hasted's *History of Kent*, published in 1798, just one hundred

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years after the preceding, is found the following account of the same fall:

"About Easter, in the year 1666, a pasture field in this parish, which is a considerable distance from the sea or any branch of it, and a place where there are no fish ponds but a scarcity of water, was scattered over with small fish, in quantity about a bushel, supposed to have been rained down from a cloud, there having been at that time a great tempest of thunder, hail, wind, etc. These fish were about the size of a man's little finger; some were like small whittings, others like sprats, and some smaller like smelts. Several of these fish were shown publicly at Maidstone and Dartford."

Raphael Eglini, in the *Wittenbergischen Wochenblatt* for 1771, reports an alleged rain at Cotbus on the midnight of September 2-3, during a heavy thunderstorm. He did not see it, but a number of the fishes, 5-6 inches long, which were said to have fallen, were sent to him. Although the account was attested by various friends, Eglini was doubtful. He suggested that these fish, if identical with those found in the neighboring streams, might have been carried to Cotbus by a waterspout or an overflow. Here, in the third recorded account of a fall of fishes, it may be noted that the correct explanation of the cause of the phenomenon is alleged.

In a later number of the same journal for the same year, Eglini discusses the accounts of this same *Fischregen* supplied by other correspondents. One of these had collected some of the fish at Luckau, a near-by point, which he sent to Eglini. These Eglini found to be specimens of a trout found in the Mark and in Schleisen (but by inference not very near Cotbus); whereupon he at once pronounced the matter as incredible, especially as he had a letter from another gentleman who was out in that very storm and saw no fishes fall with the rain.

John Harriott in 1809 recounts, presumably from his own observation, the following phenomenon:

"In a heavy shower of rain, while our army was on the march, a short distance from Pondicherry, a quantity of small fish fell with the rain, to the astonishment of all. Many of them lodged on the men's hats; when General Smith, who commanded, desired them to be collected, and afterwards, when we came to our [camping] ground, they were dressed, making a small dish that was served up and eaten at the general's table. These were not *flying fish*, they were dead, and *falling* from the common well-known effect of gravity; but how they ascended, or where they existed, I do not pretend to account. I merely relate the simple fact."

In the *Annals of Philosophy* for 1816 is found the following account, in a section presumably from the pen of the editor, Thomas Thompson:

"In Prince of Wales Island, in the East Indies, the inhabitants usually catch the rain-water in tanks placed on the tops of their houses. Frequently these tanks are completely dry for weeks together. When the rainy season comes, they are speedily filled with water. Some fishes are found swimming about in this water, which gradually increase, and acquire the length of several inches. I have been told that the same thing happens in Bengal. These fishes must come down with the rain. It is a matter of some curiosity to be able to explain the source from which these animals are derived. . . . My information was obtained from an East India Captain, who assured me that he had seen the fishes frequently, though he was ignorant of their name, and could not describe their appearance with sufficient precision to enable us to make out the species."

In Rees's *Cyclopædia*, Volume XXX, 1819, under the heading, "Rains—Preternatural," it is stated that after a very heavy storm, which blew down trees, houses, etc., the streets of a town near Paris were found covered with fish of various sizes up to five or six inches long. Everyone agreed that they had fallen from the clouds brought in by heavy winds. It was noted later that

fish ponds in the neighborhood were empty of all but large fish, the small ones having presumably been carried out over the city.

We next come to the classical account given in 1823 by Alexander von Humboldt of the eruption of Mt. Carguairazo, north of Chimborazo, which in 1698 covered the surrounding country to the extent of about forty-three square miles with mud and fishes. Furthermore, he tells us that seven years before the event referred to, the volcano Imbaburu had thrown out so many fishes that these on decomposing caused a fever which devastated the town of Ibarra. The fish in question was a singular catfish to which was given the name *Pimelodus cyclopum*. The causes active here were, however, entirely different from those producing the other rains of fishes referred to in this article, the agencies being earthquakes and volcanic eruptions, which hurled the waters of lakes with their fishes high into the air.

In the *Edinburgh New Philosophical Journal* for 1826 are found several accounts of falls of fishes in Scotland. The first is a reference to Andrew Symson's "Large Description of Galloway," which was written in 1684 but not published until 1823. Symson says that a shower of herring was seen to fall in Galloway some sixteen miles from the sea but not far from the water of Munnach. He did not see this himself, but says that it was reported by credible witnesses and that some of the fish were said to have been carried to the residence of the Earl of Galloway and exhibited to him.

Next are the accounts, by the Rev. Colin Smith, of Appin, of falls in Argyllshire, Scotland, which read as follows:

"... the testimony of many has enabled me to ascertain that a shower of herring fell in Lorn, about the year 1796, yet I have not met anyone who could inform me of the particulars concerning it.

"In the same district, and near the same place, on a small eminence above

Melford House, a shower of herring fell in 1821, in every respect so large and good, that the tenants by whom they were found were induced to send some of them to their landlord, then residing in Edinburgh. In regard to the state of the weather, I could learn no more than that it was exceedingly boisterous; while the hill on which they were found is exposed to the southwest wind, which blows along Loch Milford, an arm of the sea in which herrings are frequently found.

"In the month of March, 1817, strong gales of wind from the north were experienced in Appin. Upon the evening of the second day of their continuance, rain fell in abundance; and next day being very warm and sultry, some children observed a large quantity of herring-fry scattered over a moss a little to the northeast of the ferry of Shien. There might have been about three barrels or more of these, and measuring from $1\frac{1}{2}$ to 3 inches in length. Now, the place in which they were found is only 300 yards north of Loch Creran, an arm of the sea running east and west, from which several supposed the fry must have been raised. The wind, however, being from the north, renders this a seeming impossibility; and it may, perhaps, be more safely concluded that they must have been ejected from the Linnhe Loch, another arm of the sea, extending southwest and northeast, about 3 miles north of the place in which they were found. A range of moorland, about 300 feet above the level of the sea, intervenes; but it is easier to suppose the cause which originally elevated these fry to be so powerful as to carry them this height and distance, than that they should obtain a course contrary to the general body of air. They exhibited no appearance of being bruised by the fall."

The last account in the *Edinburgh New Philosophical Journal* for 1826 is from a man named Arnot, who told the editor, Robert Jameson, that in 1825 a shower of herring fell near Loch Leven in Kinross-shire, the wind at the time blowing strongly from the Frith of Forth. Hence it was concluded that they were blown out of the Frith, carried by the

wind across Fifeshire, and let fall in the vicinity of Loch Leven.

There is also said to be an account of a rain of fishes in the *Inverness Courier* of April, 1828, but it has been impossible to verify this.

In 1828, a short account was published in the *Gentleman's Magazine* of a rain in Ross-shire, Scotland. The full account follows:

"As Major Forbes Mackenzie of Fodderty, in Strathpeffer, Co. Ross, was traversing a field on this farm, he was surprised to find a considerable portion of the ground covered with herring fry, of from three to four inches each in length. The fish were fresh and entire, and had no appearance of being dropped by birds, a medium by which they must have been bruised and mutilated. The only rational conjecture that can be formed of the circumstance is, that the fish were transported thither by a waterspout—a phenomenon that has before occurred in this county, and which is by no means uncommon in tropical climates. The Frith of Dingwell lies at a distance of three miles from the place in question, but no obstruction occurs between the field and the sea—the whole is a level stretch or plain—and waterspouts have been known to carry even farther than this. Major Mackenzie has forwarded a small quantity of the fish to the secretary of the Northern Institution."

Chronologically the next account is from America, namely Cambridge, Maryland. J. E. Muse tells in 1829 of a ditch dug one mile from the river and in land ten feet above water. This had no connection with any body of water and for ten days after being finished remained dry. Then came a week or ten days of heavy rain which filled the ditch and in the ditch were found hundreds of small sun perch and jack perch from four to seven inches long. The author has no explanation, but it would seem that a "rain of fishes" is the most reasonable supposition and hence the account is included here.

The next account takes us to the South Sea Islands, and is recorded in the *Polynesian Researches* of that keen-sighted of all the missionary observers of natural history in the South Seas, William Ellis. In the first edition of his invaluable work (1830), in Volume II, p. 285, is the following account of an observation made at some one of the Society Islands, probably Tahiti itself:

"Connected with the fresh-water fish, a phenomenon is often observed for which the natives are puzzled to account. In the hollows of the rocks and in other places, to which they suppose that the sea and the river never gain access, and where the water collected is entirely what falls from the clouds, small but regularly formed fish are sometimes found. The people have frequently expressed their surprise at finding them, and appeared to wonder how they ever came there. They call them *topatana*, literally, rain-drop, supposing that they must have fallen from the clouds with the rain."

There are now to be recorded a number of accounts from India, where it would seem this phenomenon is not unusual. The first, published in 1833, is from the pen of James Prinsep, long the secretary of the Asiatic Society of Bengal and a scientist of the utmost credibility.

He states that concerning the phenomenon of fish falling from the sky, he was absolutely incredulous until "I once found a small fish, which had apparently been alive when it first fell, in the brass funnel of my pluviometer at Benares, which stood on an isolated stone pillar, raised five feet above the ground in my garden." He then records a similar happening on a much larger scale, which was communicated by a Mr. Cameron, who took the pains to have the depositions of ten native witnesses taken and attested before a magistrate. The shower of fish referred to took place on February 19, 1830, near the Nokul-hatty factory, Zillah Dacca, Jelalpur,

India. All agree as to the place, month, day, and hour; the discrepancies in the individual recitals are such as are to be expected from ten witnesses who were not in collusion. These accounts, omitting all irrelevant statements, will now be given *seriatim*. Two of the ten witnesses reported jointly, their statement being embodied under 1:

1. "That on Friday, in the month of Phalgun [on the ninth day,] at 12 o'clock P. M., the sky being cloudy, there was a slight rain, and a number of fish of different kinds and sizes fell from heaven; we took some of these fish and retired home."

2. ". . . I perceived a *boduli* fish, large about one cubit, fall before me from the sky; after which I went further, and found another fish of the same size, lying upon the ground. I picked up these two fish and proceeded forward; and as soon as I arrived at home, I found, to my great surprise, that many persons had likewise collected fish, and carried along with them."

3. ". . . the clouds being gathered together, began to rain, and a little after, many fish, large and small, began to fall from the sky. I picked up some of them and carried to my house, but I did not like to taste any of them."

4. ". . . while I was sitting in the front part of my cottage, I observed a *mirgal*, and some other fish, *bodulis*, etc., . . . of different size, fall from the sky. I picked up about five or six of these fish to satisfy my curiosity, but afterwards threw them away, and did not eat them at all."

5. "I had been doing my work at a meadow, where I perceived at the hour of 12 o'clock, the sky gather clouds, and began to rain slightly, then a large fish touching my back by its head fell on the ground. Being surprised, I looked about, and behold a number of fish likewise fell from heaven! they were *saul*, *sale*, *guzal*, *mirgal* and *boduli*. I took 10 or 11 fish in number, and I saw many other persons take many—then I returned home, I looked at heaven, and I saw like a flock of birds flying up, but these my

perceptions were not clear enough. Amongst these fish, many were found rotten, without heads, and others fresh and perfect; and amongst the number which I had got, five were fresh and the rest stinking and headless."

6. "While I was sitting in my own house, I perceived a number of fish fall from the sky, some of them on the roof of my cottage; one of them was large, about one cubit, and three seers¹ in weight."

7. "When I was at work in a field, I perceived the sky darkened with clouds, began to rain a little, and a large fish fell from the sky. I was confounded at the sight, and soon entered my small cottage, which I had there, but I came out again as soon as the rain had ceased, and found every part of my hut scattered with fish, they were *boduli*, *mirgal*, and *nouchi*, and amounted to 25 in number."

8. ". . . as I was coming from the fields, I saw a number of fish spread on the bank of a *nálá*. I picked up six of them, viz. two *boduli*, two *mirgal*, and two *nouchi*, besides these there were many other fish of numerous kinds, and they were witnessed by many persons who were there. Some of these fish were fresh, but others were rotten and without heads."

9. "I sat down near the door of a workman's cottage; it was then precisely 12 o'clock, when a drizzling rain began to fall; and at the same time, two *boduli* fish fell down from heaven. I soon got up and marched on, and in midst of the road, saw several other fish fallen before me. I picked up some of these fish—but one named Banchha Ram Chung forbade me, saying, 'Do not touch these fish; you do not know what fish they are, and how they have fallen here.' Listening to him, I threw away all the fish, and went away."

In the following year a writer signing himself "S" records in these words a fall of fish at Futtehpur, India, on May 16 or 17:

"At noon . . . a blast of high wind, accompanied with much dust, . . . came on; the blast appeared to extend in breadth about 400 yards. . . .

¹A seer, or ser, is a little over two pounds.

When the storm had passed over, they [the zemindars and others, who reported it to him] found the ground, south of the village, to the extent of two bighas,¹ strewn with fish, in number not less than three or four thousand. The fish were all of the *Chalwa* species (*Clupea cultrata*) a span or less in length, and from one to one and one-half a seer in weight; when found, they were all dead and dry. *Chalwa* fish are found in the tanks and rivers in the neighborhood. The nearest tank in which there is water is about half a mile south of the village. The Jumna runs about three miles south of the village, the Ganges 14 miles north by east."

The next account is found in the "Extracts from the Minute-Book of the Linnean Society" of London. The account was read before the Society on June 15, 1830, but was printed in 1833, in Volume XVI of the *Transactions*. Verbatim it reads:

"[There was] Read an extract of a letter from Mrs. Smith, dated Moradabad, July 20th, 1829, to a gentleman in Somersetshire, giving an account of a quantity of Fishes that fell in a shower of rain at that place. Many were observed by Mrs. Smith from the window of her residence, springing about on the grass immediately after the storm. The letter was accompanied by a drawing taken on the spot, which represents a small species of *Cyprinus*, two inches and a quarter in length, green above, silvery white below, with a broad lateral band of bright red."

At the meeting of the British Association for the Advancement of Science in 1840, Colonel Sykes read a letter from a Captain Ashton located at Kattywar, government of Bombay, India, referring to the fall of fishes recorded by Harriott in 1809.

There is now to be given the brief account written by De Kay in 1842 which first interested me in the phenomenon of the rain of fishes and which ultimately led to the writing of this

paper. De Kay says that "in the summer of 1824, a number of these fish [*Batrachus*, now *Opsanus tau*] were found in the streets of New York after a heavy shower." He adds that these little fish are carried up by whirlwinds or waterspouts, and that they are very tenacious of life.

In 1849, Thompson mentions a number of falls previously referred to in this article and then records, without citing his source of information, that in Argyllshire, Scotland, in the little island of Ula, after a heavy rain there were found scattered over the fields a number of small herrings, all perfectly fresh, and some scarcely dead; furthermore, that a fish, ten inches long, together with smaller ones, fell at Boston, Massachusetts, on June 30, 1841, and that in July of that year a shower of fish and hail occurred at Derby, England; that in 1829 at Moradabad, India, numbers of a species of *Cyprinus* fell; that on September 20, 1839, a number of living fish about three inches long rained down at a place twenty miles south of Calcutta.

Dr. Buist¹ in the *Bombay Times* of the year 1856, after discussing rains of fishes in various parts of the world says that in 1824 fishes fell at Meerut on the men of Her Majesty's 14th Regiment, then out at drill, and were caught in numbers. At Allahabad in 1835, there was a fall of fish during a heavy storm. No particulars are given, but it could not have been a case of aestivation or migration, since the fish were found dead and dry after the passage of the storm. Again at the Sunderbunds, about twenty miles south of Calcutta, on September 20, 1839, there fell in a heavy squall a number of small, live fish about three inches long. These were not scattered over the country but were found in a long, narrow, and fairly straight row.

Buist records two other significant

¹A bigha is about one-third of an acre.

¹This citation is found in Tennent (q.v.) and has not been verified by the present writer.

falls. In 1850, on July 25, there was at Kattywar a tremendous deluge of rain: thirty-five inches fell in twenty-six hours; twenty-seven inches in twenty-four hours, and seven and one-half inches in one and one-half hours. This brought with it so many fish that the ground was literally covered, and some were even found on the tops of haystacks. And two years later at Poonah, after a heavy rainfall, multitudes of fishes were picked up on the cantonment grounds, which were situated a full half-mile from the nearest stream. All these falls noted by Buist are alleged to have been accompanied by heavy wind and rainstorms.

Boll in 1858 quotes a newspaper account of a heavy storm very like a waterspout that broke over Lake Plauer in Mecklenburg and the neighboring country. This storm tore great holes in the hills and filled these with water in which were found on the following day numerous small, living fishes and crustaceans. Boll also quotes the *Monatschrift von und für Mecklenburg* of 1795 (p. 310) to the effect that a similar heavy storm in the year 1795 passed over Lake Müritz, scattering fishes on the pasture and cultivated land adjoining. I have not been able to find the *Monatschrift* in America and have not been able, therefore, to verify the citation.

In the *Proceedings of the Boston Society of Natural History* for 1859, Volume VI, there is noted a letter from Prof. O. P. Hubbard, of Dartmouth College, in which he gave an account of a fall of fish at a town in Vermont, that occurred during a sudden squall of wind accompanied by rain, and he furthermore stated that this was but the last of a number of similar instances which had come to his notice.

Tennent in his *Natural History of Ceylon*, published in 1861, records a number of instances of falls of fishes in India and Ceylon. Some of these have been noted already. Broadly speaking, he says that in Ceylon it is the

general belief that the heavy bursts of the monsoon bring falls of fishes, since fishes of small size are frequently found in hollows along the roads and in depressions previously dry and sunbaked. Speaking specifically, he states that on one occasion he saw a violent shower fall on the road just ahead of him, and that when he got there, he "found a multitude of small silvery fish one and one-half to two inches in length leaping on the gravel of the high road, numbers of which I collected and brought away. . . . The spot was about half a mile from the sea and entirely unconnected with any water course or pool." Such evidence as this from so eminent a student of natural history as Sir J. E. Tennent is absolutely incontrovertible.

Next he quotes a Mr. Whiting of Trincomalee, who claimed that he had often been told by natives of such rains of fishes and that on one occasion he was taken to a field "which was dry when I passed over it in the morning, but which had been covered in two hours by a sudden rain to a depth of three inches, in which there was seen a quantity of small fish. The water had no connection with any pond or stream whatever." On another occasion a Mr. Cripps, of Galle, wrote him that he had seen fishes taken from hollows in the land which in the dry season were completely devoid of moisture. Since there was neither running water nor tank near by, Mr. Cripps was convinced that "either the fish or the spawn from which they were produced must of necessity have fallen with the rain." As these fish were found *immediately* after the rain, it could not be claimed that either the fish themselves or their ova had been imbedded in the earth and had awakened from æstivation, moreover, the earth to a depth of from twelve to eighteen inches is ordinarily baked as hard as a brick, precluding the possibility of their being imbedded.

Perhaps the most widely known and,

because of the standing of its recorder as an ichthyologist, the most authentic case, is that made known by the Count de Castelnau in 1861. A careful translation of his account is given below. There was an earthquake followed by a tremendous rain at Singapore on February 20, 21, and 26, 1861. To this de Castelnau makes allusion and then continues:

"When the sun came out again I saw numbers of Malays and Chinese filling their baskets with fish contained in the pools formed by the rain. They told me the fish had 'fallen from heaven,' and three days later, when the pools were all dried up, there were still many dead fish lying about. I found them to belong to the *Clarias batrachus*, which can live a considerable time out of water, and even move to some distance on dry land. As they lay in my courtyard, which is surrounded by a wall, they could not have been brought in by the overflowing of a torrent, nor is there any considerable one in the neighborhood. The space covered by these fishes might be about fifty acres. They were very lively and seemed to be in good health. I have particularly remarked the singular occurrence of the fish, having already, during my stay at the Cape of Good Hope, had occasion to mention to the Academy the fact of several new species of fish being found after an earthquake. Is it permissible to suppose that a waterspout, in passing over some large river of Sumatra, had drawn up the fish and carried them over? It is not without diffidence that I venture this hypothesis."

An account of this phenomenon also appeared in the *Zoölogist*, 1861, Volume LI, and P. Harting gives the same data in *Album Natuur*, 1861. Both of these credit the data to Castelnau, but not so the anonymous writer in *Das Ausland*, 1861, 34. Jahrgang.

In his book published in 1864, Charles Tomlinson recounts a number of instances of falls of fishes. He gives at greater length the account of a fall near Calcutta in 1839, previously referred to by Buist. This is so cir-

cumstantial that it is reprinted in full.

"About two o'clock P. M., of the 20th inst. (September, 1839), we had a very smart shower of rain, and with it descended a quantity of live fish, about three inches in length, and all of one kind only. They fell in a straight line on the road from my house to the tank, which is about 40 or 50 yards distant. Those which fell on the hard ground were, as a matter of course, killed from the fall, but those which fell where there was grass sustained no injury; and I picked up a large quantity of them, 'alive and kicking,' and let them go into my tank. The most strange thing that ever struck me in connection with this event, was, that the fish did not fall helter-skelter, everywhere, or 'here and there'; but they fell in a straight line, not more than a cubit in breadth."

Tomlinson also gives without indication of source a detailed account of a fall of fishes in Scotland, which is reproduced in full.

"Still more recently a fish shower happened near Aberdare. The following passage purports to be the evidence of John Lewis, a sawyer in Messrs. Nixon & Co.'s yard, as taken down by the Rev. John Griffith, vicar of Aberdare and rural dean:—"On Wednesday, February 9th, I was getting out a piece of timber for the purpose of setting it for the saw, when I was startled by something falling all over me, down my neck, on my head, and on my back. On putting my hand down my neck, I was surprised to find they were little fish. By this time I saw the whole ground covered with them. I took off my hat, the brim of which was full of them. They were jumping all about. They covered the ground in a long strip of about 80 yards by 12 yards, as we measured afterwards. That shed (pointing to a very large workshop) was covered with them, and the shoots were quite full of them. My mates and I might have gathered buckets full of them, scraping with our hands. We did gather a great many—about a bucket-full—and threw them into the rain pool, where some of them now are. There

were two showers, with an interval of about ten minutes, and each shower lasted about two minutes, or thereabouts. The time was eleven A. M. The morning up-train to Aberdare was just then passing. It was not blowing very hard, but uncommon wet; just about the same wind as there is to-day (blowing rather stiff), and it came from this quarter (pointing to the S. of W.). They came down with the rain in a body like.'

"The Rev. Mr. Griffith adds, that 'such is the evidence. I have taken it for the purpose of having it laid before Professor Owen, to whom, also, I shall send to-morrow, at the request of a friend of his, eighteen or twenty of the little fish. Three of them are large, and very stout, measuring about 4 inches. The rest are small. There were some, but they are since dead, fully 5 inches long. They are very lively.' A number of these fishes were exhibited for several weeks in the Aquaria house of the Zoological Society's Gardens, in the Regent's Park, London."

Boll records (1868) the following instances of fish falling at certain points in Mecklenburg: at Steuer on July 25, 1795; at Kratzburg, on May 28, 1828; and near Dölitz, Pomerania, June 9, 1868. He says that in each case numbers of small fishes were found, and in one case fairly large ones, and that in the first two instances the rain was accompanied by a waterspout.

A similar occurrence is reported in 1873 by Franz Buchenau in the following words:

"Bremen, May 24. About five o'clock day before yesterday afternoon in the vicinity of Eystrup a great number of fishes fell on and beside the railroad embankment during a storm. They were little so-called whitefish. The appearance of these unaccustomed guests is connected with a waterspout, which, as was later reported to the railway directors here, arose apparently at the same time from the Steinhuder See about four miles distant."

The following account of an alleged fall of fish scales is given here because

it is allied somewhat to the present subject, and because its omission might seem somewhat serious in view of the title of the article. The account and the disposal of it are given in Professor S. F. Baird's own words (1875).

"It is stated that during a heavy thunder-storm near Lake Providence, Louisiana, a number of small bodies were found on the ground, immediately after the shower, scattered along the shore of the Mississippi River for a distance of forty miles above the lake; as many as half a bushel being collected around one house. These, on being submitted to critical examination, proved to be the scales of the common gar-fish of the South (*Lepidosteus*). The species inhabits the shallow, muddy waters of the South and sometimes attains a length of five or six feet, and is especially characterized by being enclosed in an almost impenetrable coat of mail (the scales in question), so compact as almost to resist the penetration of a bullet.

"It is very difficult to give credence to this story; as the gar-fish are not particularly abundant, and the method of aggregation of so large a number of detached scales would be a problem extremely difficult of solution. Perfectly authentic instances are on record of small fish, shells, etc., being taken up in storms and scattered over the earth; but when it comes to special portions of fishes which weigh from 5 to 50 lbs. each, the draft upon one's faith is rather too severe."

An anonymous writer in *Das Ausland* for 1878 records, on the authority of the *Toronto (Canada) Globe*, a fall of fishes which is said to have taken place in Canada through the action of a tornado. The account was vouched for by a teacher, who reported that living young herring were found scattered over dry ground for a space of three-quarters of a mile.

The next account, comparatively recent in date and very clear in statement, is by Thomas R. Baker, (1893).

"During a recent thunder-storm at Winter Park, Fla., a number of fish fell

with the rain. They were sunfish from two to four inches long. It is supposed that they were taken up by a waterspout from Lake Virginia, and carried westward by the strong wind that was blowing at the time. The distance from the lake to the place where they fell is about a mile."

Perhaps the most extraordinary case of all is that related by one Hermann Landois, whose narrative was written in 1896:

"Herr Joseph Grimberg in Essen on the Ruhr wrote me on July 27 as follows:— 'During yesterday's hail storm there fell a hailstone the size of a hen's egg, in which an enclosed fish was found frozen. The storm lasted about ten minutes. . . . The fish was picked up in my presence so that there can be no doubt of the fact. The fish is a crucian carp . . . ' about 40 mm. long. This fish has up to this time been observed in Westphalia only in enclosed waters. The fish must have been lifted up from a pond or pool into the clouds by a whirling storm and there frozen into a hailstone."

The *Monthly Weather Review* for June, 1901, contains the interesting account from Mr. J. W. Gardner, volunteer weather observer at Tiller's Ferry, South Carolina, U. S. A., that "during a heavy local rain about June 27, there fell hundreds of little fish (cat, perch, trout, etc.) that were afterwards found swimming in the pools between the cotton rows in [an adjacent] field."

The last account but one to come to hand was given before the Berlin Society of Naturalists on July 20, 1841, but was not published until 1912. It is very detailed and is here given practically in full.

"Herr August gave an account of a rain of fishes which occurred during a heavy thunderstorm on the night of June 29-30, 1841, in Uckermark on the estate of Herr von Holtzendorff-Jagow. . . . Suddenly at two o'clock in the night (30th of June), a heavy rain

began to fall, and continued so violently for the best part of an hour that the place was flooded deeper than the oldest inhabitants could remember [ever having seen it]. On the evening of June 30 the shepherds brought back with them to their huts collections of small fishes to feed their ducks with. They said that a high, fallow field which was used for a sheep pasture was entirely covered with these fishes. [They said that] during the day more than sixty storks and an innumerable number of crows had eaten their fill there and that the new-formed rain pools were filled with large numbers of these fishes. The owner of the estate, who did not hear of this until July 1st, was not able to go to the place and see for himself until July 2nd. He found that there were still a great many fishes in the places indicated. The largest of these were five inches long. The little pools in which the fishes were happily swimming about, had apparently been formed during the storm and had no connection whatever with any other body of water that contained fishes. The extent of the surface on which the fishes were found covered a length of two hundred paces and was fifty paces wide. The length agreed with the conjectured course of the thunderstorm.

"All investigations indicated that without any doubt these fishes were brought to this spot through the air. It is remarkable that such a whirling waterspout did not leave any other traces of damage done by the wind, especially as no particularly strong wind was noticed in the night; on the contrary, rain fell perfectly quietly, but in enormous quantity. In other low-lying places which were much more deeply covered with water and with meadow brooklets which connected them with ponds and lakes, no traces of fishes were to be found.

"The fishes, for the most part young, which were sent in by Herr Holtzendorff at the same time that this account was written were of varieties often found in our country, such as: pike (*Esox lucius*), perch (*Perca fluviatilis*), Plötze (*Cyprinus rutilus*) and stickleback (*Gasterosteus pungitius*)."

The last account, a brief notice, is from McAtee's paper previously referred to. He quotes Mr. A. N. Caudell of the United States Bureau of Entomology, that on one occasion after a hard shower Mr. Caudell's mother at her home in Indiana had found a live minnow in the rain water held in the hollow of a chopping-block at the wood pile.

THE CREDIBILITY OF THESE ACCOUNTS

Omitting Humboldt's account of the fall of *Pimelodus cyclopus* in hot water ejected from volcanoes in South America, since that fall has an entirely different origin and causation, there are herein enumerated forty-four distinct accounts of rains of fishes. These phenomena, when grouped under the countries where they occurred, show the following distribution: United States, 7; Canada, 1; England, 1; Scotland 9; Germany, 8; France, 1; Greece, 1; India, 10; Ceylon, 3; Malaysia, 2; South Sea Islands, 1. Surely such a large array of accounts from eleven different regions of the earth, ranging from the eastern part of North America, across western and southern Europe, touching southern and southeastern Asia, and ending in the South Sea Islands, should be credible on the bare setting forth of the facts.

Another circumstance tending to establish the credibility of these accounts is the fact that they are published in books and journals differing greatly in character. The books include works on meteorology, travel, history, and natural history; the journals are mainly devoted to natural history, but published in widely separated parts of the world, and while some of them are well known, others are comparatively obscure. A perusal of the accounts given above (most of them verbatim excerpts) must convince the reader that those who made efforts to review the literature,—Thompson, 1849; Tennent, 1861; Tomlinson, 1864; and McAtee,

1917,—had only limited knowledge of the considerable literature devoted to this subject. This is plainly due to the fact that the accounts were published in widely scattered and little known books and journals and that even as late as McAtee's paper no complete bibliography of the literature of fishes was available for any one desiring to weigh all the facts.

Now it cannot be maintained that all the accounts noted are of equal credibility. Some are mere hearsay, some are hearsay pretty well attested (i. e., matters of general knowledge in the community) and some are recorded by scientific men, who in certain instances apparently saw the fishes fall, in other instances found them immediately after a hard rain covering ground ordinarily dry,—that is ground far removed from swamps and streams. To proclaim disbelief in the phenomenon of rains of fishes, to refuse credence to accounts so widespread in time and space, so thoroughly corroborative, would in the mind of the writer be indicative of an inability properly to evaluate evidence.

As a matter of fact but two authors have endeavored to deny the credibility of such phenomena. The first of these is Eglini (1771), who in his first account (See p. 608) seems to have doubts, but on the whole accepts the fact on the assumption that it is the action of a waterspout. In his second account, written in the same year, he quotes a "scholar in Luckau who saw it," and who sent him specimens of the fish. However, because these fish apparently were not such as occur in the neighboring streams, and because he received a negative report from a "learned gentleman of Lausitz," he brands the reputed fall as a deception. The "learned man" in question was out on the evening of the storm until eleven o'clock (the storm occurred at midnight), sat at an open window almost all night, and finally was again in the open early in the morning, without seeing the least

trace of fishes. "Therefore I may affirm with certainty that the whole proceeding said to have occurred with this storm is a lie." However, he omits to say whether or not he explored the *whole* area of the track of the storm, and apparently he declares the matter a lie because he found no fishes in the vicinity of his own home.

The only author who has endeavored to controvert some of the numerous accounts given is W. Sharpe (1875). After quoting Tennent's personal experience given above, he endeavors to explain it away by alleging that the fishes are left stranded from an overflow, or are caught migrating from one point to another. He says that no scientific man has ever seen a rain of fishes, nor have fishes ever been caught in rain barrels, and finally that they are always found alive whereas, if rained down, the fall would kill them.

In answer to this it may be said that no scientific man has ever had a rain of fishes fall on him, nevertheless the testimony of Tennent, Castelnau, and others cannot be controverted away. As to the second point, let us recall that Prinsep found a fish in his pluviometer standing on a pedestal five feet above ground, and that Mrs. Caudell found one in the hollow of a chopping block at least eighteen inches above the ground. As to the fact that the fishes are commonly alive and are not killed by the fall, as Sharpe thinks they should be, the retort may be made that all fishermen know that fishes generally succumb slowly to falls and blows, and that if the fish fell on grassy lands, the shock would be much decreased. However, numbers of those found were actually dead.

THE EXPLANATION

Omitting Humboldt's account of the fall of catfish in South America, for which an explanation has already been indicated, four explanations offer themselves for the appearance of fishes accompanying heavy rains. The first of

these is that the fishes might have been migrating overland from one stream or pond to another. Now migratory fishes are of but few kinds, and are found only in a few countries. Of the countries noted above such an occurrence might take place only in India, Ceylon, or Malaysia. But the accounts of the falls of Indian fishes are so definite and circumstantial as to rule out this possibility. Again, many of the falls have taken place in northern countries, where there are no migratory fish, and finally many of the fish rained down are marine forms.

Furthermore, the fishes might have been left behind by overflows as alleged by Eglini, but there is nothing in the accounts given to lead one to such a conclusion. More plausible is the conjecture that the fish may have been aestivating and have been awakened by the coming of the rain. This might apply to Ceylon, India, and Malaysia, where there is a prolonged dry season, but during the dry season the earth becomes thoroughly baked, and even in swamps and tanks is hardened to the consistency of sun-dried bricks to a depth of from fifteen to eighteen inches. In view of this fact a mere thunderstorm or even a heavy downpour would not soften the ground sufficiently to release the imprisoned fishes. Then again many of the falls recorded have been on high and dry fields, upon the sand of parade grounds of military cantonments, and upon the enclosed compounds of residences. A careful perusal of the reported rains of fishes in Ceylon, India, and Malaysia, will eliminate the explanation based on the awakening of fishes from summer sleep due to the falling of heavy showers.

There is left to us but one other explanation,—the action of heavy winds, whirlwinds, and waterspouts. Practically all those who have described rains of fishes have noticed that these were the accompaniments of thunderstorms or monsoon rains with their heavy winds, or of waterspouts. One who has wit-

nessed the activities of a whirlwind or who has seen the wreckage left in its path will have no difficulty in believing that such a whirlwind or even the heavy winds accompanying a hard storm could pick up and transport to some distance objects of such light weight as small fishes. Furthermore, anyone who has witnessed the tremendous power of waterspouts, such as are common for instance in southern Florida, will agree that such a spout passing over shallow water, would certainly pick up the small fishes swimming therein and, drawing them up into the

clouds, would carry them over the country to drop them some distance away. This is the only explanation that can account for the Indian fall as a result of which fishes were found in a comparatively straight path only a few inches wide, extending over a considerable stretch of country. These fishes must have fallen from the whirling lower end of a funnel-shaped spout after the pillar had broken in two, as is often the case. Again, no other explanation can account for a fall concentrated on a comparatively small area, as was that noted by Castelnau at Singapore.

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ERWIN S. CHRISTMAN AT WORK ON THE MODEL OF "BRONTOTHERIUM"

Mr. Christman's untimely death, on Nov. 27, 1921, has deprived science of the service of an artist whose work was characterized not only by creative vision but by fidelity of detail. The model of the head of *Brontotherium* is one of the many striking and scientifically accurate restorations of extinct animals which he made during his twenty-one and one half years of devoted service as draughtsman, artist, and sculptor, in the department of vertebrate palæontology of the American Museum



Christman's models of the first and last of the titanotheres: *Eotitanops*, the small animal at the right, and *Brontotherium*, its gigantic descendant.

These models, which were worked out by Mr. Christman under the direction of members of the scientific staff, illustrate his exceptional skill in fusing the results of patient investigation along many lines into a consistent whole, and in inspiring the "dry bones" of science with the vitality and movement of living animals

ERWIN S. CHRISTMAN, 1885-1921

DRAUGHTSMAN, ARTIST, SCULPTOR

BY

WILLIAM K. GREGORY*

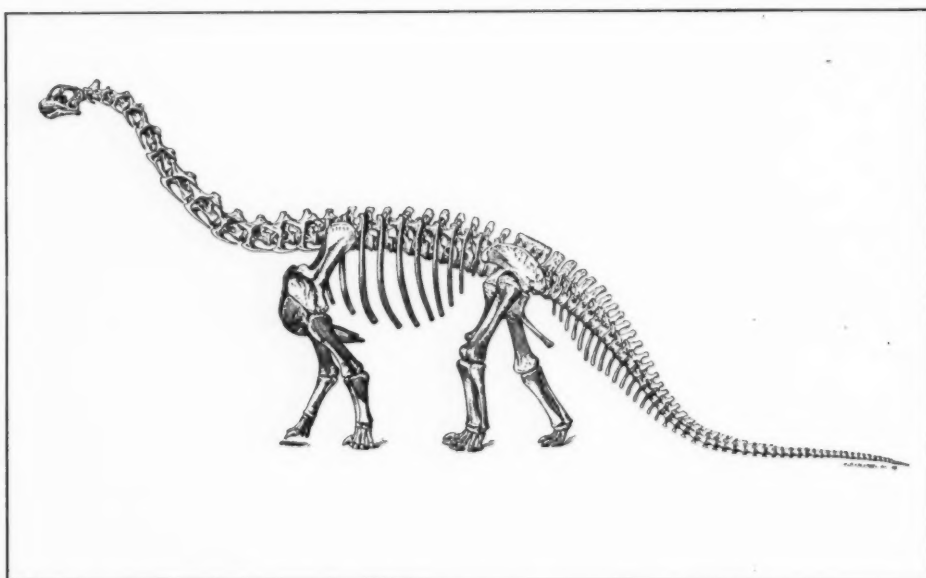
ALTHOUGH Erwin Christman of the American Museum died at the early age of thirty-six, he left behind him a splendid record of twenty-one and one half years' service, through the medium of art, to science and education. He came to the Museum when he was still in knickerbockers and began at once to make a trial series of drawings of mammal skulls in the department of vertebrate palæontology. From the first he worked under the immediate supervision and direction of Professor Henry Fairfield Osborn, who devoted much time and thought to the boy's technical training and succeeded in inspiring him with a fidelity to truth and beauty which showed increasingly as the years passed.

His early work revealed a keen sense of light and shade and of perspective, but at first he could hardly catch the subtle unevenness and individuality of the contours of teeth and bones. However, as his studies in the Art Students League and at the National Academy of Design progressed, his lines became surer and gained in accuracy. For some years "Erwin," as he was affectionately called in the department, concentrated upon wash drawings and eventually produced his superb figures of the teeth of titanotheres and other extinct mammals. Of late years he worked largely in pen line, gaining constantly in clearness and simplicity of presentation and finally completing a wonderful

*Curator, Department of Comparative Anatomy, American Museum.

series of drawings of the remains of various dinosaurs, especially *Tyrannosaurus* and *Camarasaurus*. He early showed a strong inclination for work in the round, and the hall of vertebrate palæontology contains many excellent models and restorations made by him, including the magnificent series of titanotheres heads, the stirring models of the race horse Sysonby, of the giant dinosaur *Camarasaurus*, and of *Brontotherium*.

with unending patience and enthusiasm the elaborate construction of the backbone of this monster, making hundreds of drawings of the separate vertebræ, correcting the distortion of the crushed bones, and supplying in dotted lines the probable appearance of missing parts as deduced from comparison with other specimens. The *Camarasaurus* bones—the remains of several individuals—were found in a quarry, scattered in almost



Christman's pen drawing (greatly reduced in size) of the skeleton of the gigantic dinosaur, *Camarasaurus*. From the Memoir on *Camarasaurus* by Professor Henry Fairfield Osborn and Dr. Charles Craig Mook.

This drawing and the model of the same animal shown on the opposite page were the crowning achievement of Christman's years of work in drawing the scattered and often crushed fossil bones of this dinosaur

Christman was not only an accurate draughtsman and modeler, he was also a highly intelligent and sympathetic assistant to the members of the scientific staff in working out difficult problems of reconstruction. His model of *Camarasaurus*, for example, is the culmination of a series of operations extending over many years and involving numerous special investigations in which he took an active part. Under the guidance of members of the scientific staff he studied

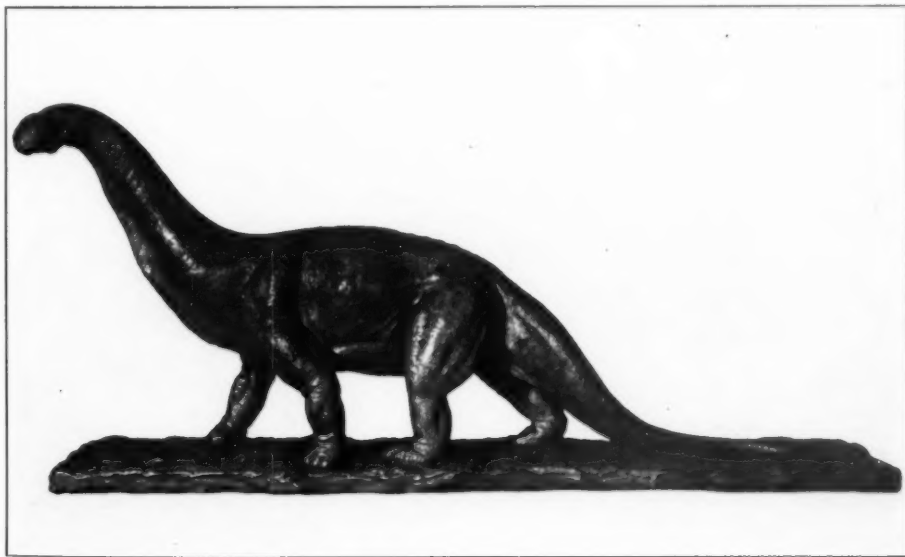
hopeless confusion. As the individual vertebræ are too heavy to be handled easily, and literally too big to be studied closely in series, Christman's drawings afforded the means of making effective comparisons of the vertebræ with others of the same animal and with homologous vertebræ of other individuals. After the probable associations of vertebræ with each other and with the appropriate girdle and limb bones had been worked out, Christman made a new set of draw-

ings on a smaller scale of every part of the completed animal. Each of these drawings he then carefully cut out with scissors and fastened to flexible copper wires. The model of the whole vertebral column was then laid out on a black background and adjusted to similar models of the ribs, girdles, limbs, and skull. By means of this flexible model various possible poses of the skeleton were represented and photographed. After a certain general pose of the skeleton was agreed upon, Christman constructed a plasticene mannikin of the skeleton, accurate in proportions and mounted on flexible lead wires. The next step was to determine the location of the principal muscle masses of the girdles, limbs, and body. This again was a by-product of previous studies of the musculature of reptiles and mammals and Christman showed his usual intelligence and skill in adapting this knowledge to the special problems in

hand. Thus he produced one of the most successful of all restorations of dinosaurs yet made.

Similarly the working out of the restorations of the titanotheres heads involved, in each case, the making of accurate reconstructions of the skull and lower jaw, the determination of the areas of origin and insertion of the principal muscles of the face, jaws, and neck, as well as the decision as to the most probable form of the mouth and lips. The methods adopted in modeling these heads are partly indicated in the figures on page 625.

With the same conscientious exactness he also worked out the designs for the principal group exhibits of extinct animals. The ground sloth group and the asphalt group in the hall of the Age of Man, and the partly finished *Tyrannosaurus* and Miocene water hole (*Moropus*) groups, are his most important achievements in this line. All these



Christman's model of the *Camarasaurus* is one of the most successful of all restorations of dinosaurs yet made.

The close study of recent reptiles which the artist undertook has contributed to the lifelike appearance and suggestion of ponderous movement of the monster. The model is, however, far from being a mere composite of features borrowed from recent reptiles; it has an individuality of its own. One reason for the authentic effect is that the restoration is based upon the carefully worked out studies of the skeleton described in the text



GALLOPING HORSES

This inspiring group in bronze was a by-product of Mr. Christman's studies on the anatomy of recent horses. The original is the property of Professor Henry Fairfield Osborn



Christman's models of the skull and head of an Eocene titanotherium, *Palaeosyops*.—The reconstruction of the skull is based upon a study of numerous specimens, no one of which is sufficiently well preserved to show all the specific characters of the animal. Such an accurate model gives the correct placing of the ears, eyes, nose, and mouth, and the probable position of the principal muscle masses of the neck, head, and face

groups except the last, before being constructed in the large, were worked out not merely as sketches but as carefully measured and studied miniature models.

Thus in many ways Erwin Christman was an invaluable factor in the scientific and educational work of the department of vertebrate palæontology and, as his experience was unique, there is literally no one in this country or abroad who can fill his place.

Christman was a strong, consistent character, rich in the most attractive

human virtues, such as kindness, modesty, and fidelity. Highly musical and of a sensitive temperament, he sometimes overtaxed his nervous endurance; but his love of outdoor life and his labors in building up a charming home in the country for his family made him strong in body and kept him young and playful in spirit. He died suddenly of appendicitis on November 27, 1921, leaving a widow and three children. The deep sympathy of all the Museum staff goes out to them.



ON GUARD

With her round head thrust out of the nest hollow in a dead yellow pine the little owl gravely surveyed the visiting strangers. Owls of this species usually occupy deserted woodpeckers' holes or other excavations

GLIMPSES OF THE HOME LIFE OF THE SAW-WHET OWL*

BY

ROBERT B. ROCKWELL AND CLARK BLICKENSERFER

STUDENTS of the Great Outdoors will all agree that the most delightful experiences with wild creatures usually occur at the most unexpected times and under the most unusual conditions, and such was our experience with the saw-whet owl, *Nyctala Acadica*.

The accommodating authors of standard ornithological textbooks have generously scattered these interesting little owls from southern Canada across the United States and far south into Mexico; and local authorities on Colorado birds have even gone further and conveyed the impression that the saw-whet was a rather common resident of the lower mountains of the state. All of which may be true if the whole truth were known, but when after nearly twenty years of roaming over mountain, hill, and valley in quest of new bird friends we had failed to come upon even a hint of the presence of the little fellows, we became convinced that the saw-whet owl, in so far as Colorado was concerned, was a myth.

Then came our first big surprise. The scene was a deep cañon-like ravine, drained by a small, clear stream flowing into Clear Creek Cañon at a point about five miles above the town of Golden. The bottom of the ravine was barely a dozen yards wide, with mountains rising abruptly a thousand feet or more on each side, clothed with a scattered growth of yellow pine. The course of the little stream was bordered with a beautiful growth of Douglas fir, Colorado blue spruce, and numerous varieties of handsome shrubs. Truly it was a spot dedicated to solitude and natural beauty.

Our day had been a lazy one, spent in renewing old acquaintances among the birds, with no thought of additional

discoveries, as we had worked this country over thoroughly in preceding years. In our stroll up the ravine we came to an ancient stump of a giant Douglas fir, weather-beaten and decaying, but with a likely-looking cavity in one side—just the place to find our old friends, the red-shafted flickers. So we rapped indifferently on the old stump, fully expecting to enjoy the flash of brilliant red wings as mother flicker, answering our knock, suddenly decided that discretion was the better part of valor. Instead, to our amazement, after repeated knocking, out popped the little round head and blazing yellow eyes of an owl, and our surprise was doubled when we realized that our new friend had no ear tufts. What could it be? Not a screech owl, because that little pal of ours had ear tufts and was gray. This new friend had none and was brown! Then we tried to recall almost forgotten descriptions of owls that might fit—Richardson's, pygmy, ferruginous pygmy, flammulated screech, and elf. One by one they were discarded as impossible, and then it dawned upon us that here at last we had discovered our myth—the saw-whet owl.

Sitting there in the entrance to the cavity barely five feet from us, her big yellow eyes ablaze, very much awake and equally unafraid, she made a very comical picture, reminding us of a tiny gladiator challenging us with her great eyes to mortal combat. She sat perfectly still, watching us closely with an expression on her funny little face (if the term is permissible) of mingled surprise and indignation. Not until we started noisily to climb the stump did she deign to move, and then she launched herself awkwardly into the air and with rapid, weak, and irregular wing-beats fluttered to the lower limbs of an over-

*Photographs by the authors



Roused by repeated knocking, the occupant of what seemed a flicker's nest at last came to the entrance to confront the rude disturbers of her tranquility, and great was their surprise to note that the bird was an owl

hanging evergreen a few feet away and from there watched subsequent proceedings with a lively though silent interest.

We begrudged the moments spent in climbing the seven feet of stump to the entrance of the nest and when we did get a peep, we found to our disgust that the cavity was too deep for us to see the bottom and too small to admit our arms, so to our regret we had to cut away part of the rotting wood. When this was done, we hauled triumphantly forth one of the scrawniest, most woe-begone little creatures imaginable, with a great homely "nose," heavy, awkward feet, and a puny body covered with soiled whitish down. Its eyes were not yet open, and the feeble neck seemed unable to carry the weight of its abnormally large head and beak, so that it lay flat in our hands, apparently quite helpless, but uttering frequently a soft, musical little "cheep" not unlike that of a freshly hatched chick. After examining it for

a moment we replaced it in the nest and then discovered that the cavity also contained three very dirty, blood-stained eggs, which had originally been white, and which were apparently about ready to hatch. After descending the tree, we watched the parent bird for some minutes at a distance of not more than a dozen feet. During this time she repeatedly flew from the dense shade of the pine, where she first sought refuge, to the nest, but at our least movement of approach she would pop out of the cavity and flutter back to the sheltering pine. At last we regretfully departed for fear the eggs might chill. We had left the stump but a few feet behind when the little mother fluttered back to care for her treasures.

A week later we called again to get better acquainted, and found the old stump lying prostrate. Three bedraggled little corpses told an eloquent tale of another forest tragedy, but the bereaved mother was nowhere to be found. To this day—and that was on June 11, 1917—we have a creepy feeling that we were in some unexplained way criminally responsible for the catastrophe.

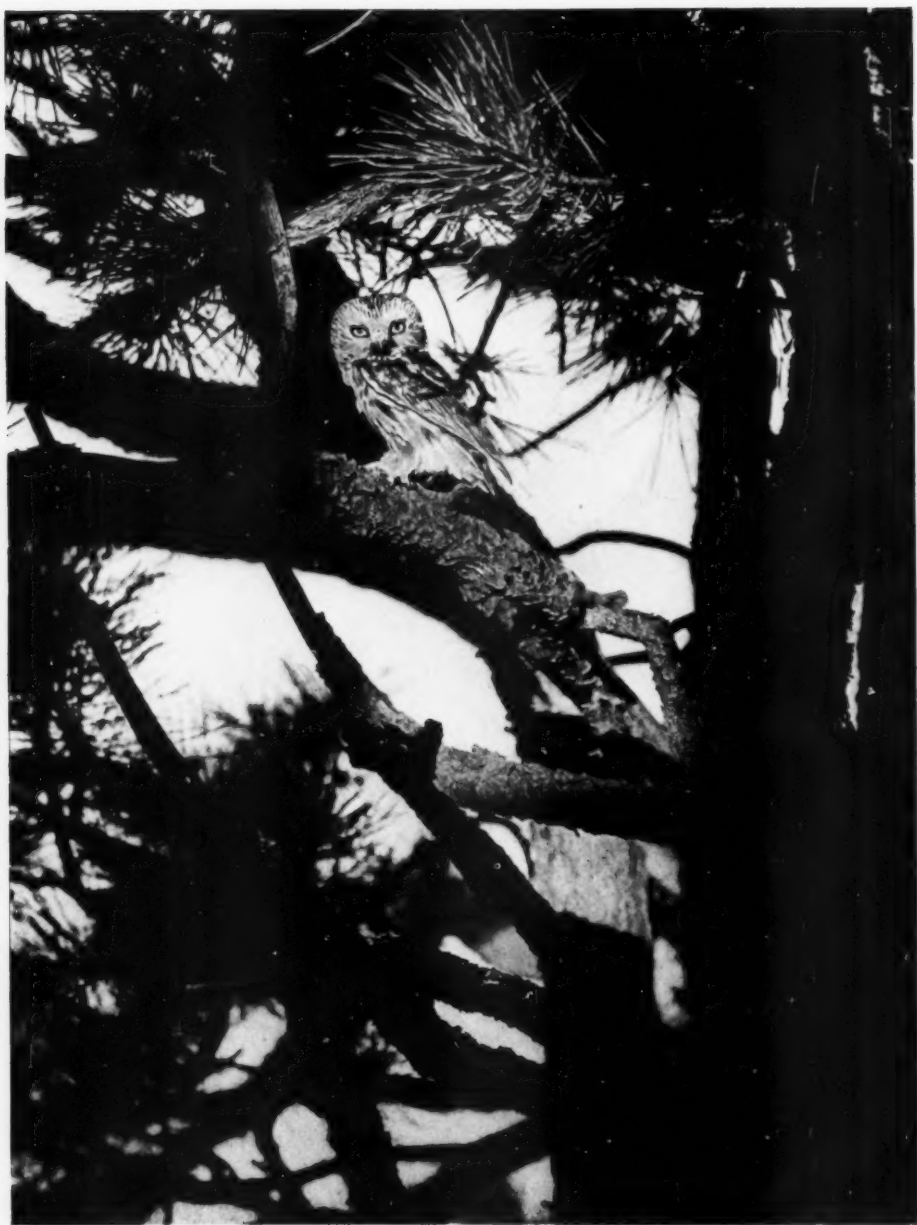
Our second meeting with these owls was fully as surprising as our first. About thirty members of the Colorado Mountain Club were enjoying the Annual Bird Study Trip in the Wildcat Point country. This area, which lies about twenty-five miles south of Denver, consists of a high plateau, its western edge bordered by rim rock and broken by deeply eroded ravines and valleys the waters of which descend abruptly into Plum Creek drainage area about five hundred feet below. The slopes of these valleys support a scattered growth of fine yellow pines with numerous Douglas fir in sheltered spots on the slopes with northern exposures.

The day, save for a large migratory flight of piñon jays, had been a disappointing one for the would-be bird students. On our way back to the waiting automobiles we clambered over the rim rock and started down the steep



AT WORK

The picture shows the specially designed twelve-foot tripod and the mirror (on an adjustable tripod top) to reflect sunlight on the shady side of the tree. This picture also gives a good idea of the country in which the nest discovered on May 9, 1918, was located



INTENTLY WATCHING THE PHOTOGRAPHER

Driven from her nest, the owl took refuge in a pine tree near by and gave the photographer the opportunity to secure this characteristic picture

slope through the fringe of pines that skirted its base. In so doing our path led directly under a large dead yellow pine. We happened to be the last of the party and as we passed this tree, we made our discovery—the round, fluffy head of a saw-whet snugly framed in an old woodpecker hole about ten feet above our heads. We called the entire party back to where we stood in full sight of the owl and told them to locate a bird within a few feet of them. Thirty pairs of excited eyes, after several minutes' search, failed to locate the bird and when she was pointed out to the party, bedlam broke loose (a large proportion of the party were ladies).

In spite of all the noise the brave little mother gazed forth calmly from her retreat and not until the ascent of the tree was begun did she seek safety in flight. She fluttered to a pine tree near by with rapid but rather awkward wing-beats, with the crowd in wild pursuit. Once in the deep shadows of the pine, she apparently overcame her fear and permitted us to come within a few feet of her. One of the party almost touched her with his hand before she again took flight and disappeared in a thicket of firs where we were unable to locate her.

Three days later, on May 12, 1918, we returned to the nest site without the crowd, and loaded down with our photographic equipment we toiled up the steep hill. As before, the mother bird greeted us at the entrance to her home and we took the first of our series of pictures of her in this position. After taking these photographs we climbed the tree and carefully cut out a piece below the entrance hole to permit a good view of the interior. An examination of the nesting cavity, which was about ten inches deep, revealed four soiled white eggs lying on an accumulation of chips, bits of rotting wood, and other débris, without any evidence of an attempt at lining the nest. The eggs were apparently far advanced in incubation, so, after carefully nailing the piece of the

trunk back into place, we hurried away to give the mother an opportunity to return to her eggs.

The location of this nest was so unusual as to be worthy of comment. All authorities agree that this species is essentially a bird of the deep forest; that the nests are invariably located in shady spots in heavy timber and usually close to running water or swampy ground. The tree in which this nest was located was on an exposed slope commanding a wide view of the adjacent country. The surrounding timber was sparse; the nesting cavity faced directly south into the bright sunlight and was unshaded except for a single overhanging dead branch; and the immediate surroundings were very dry. The nearest stream was fully half a mile distant and there was not even a trickle of spring water closer at hand. Taking everything into consideration, the nesting site differed altogether from the typical locations described by the various authorities on the subject.

On June 5 we again returned, and to our delight found four tiny birdlings apparently only a few days old, identical in appearance with the one we had seen the preceding year. We were immediately impressed with the striking difference in size of the four babies, the largest being fully twice the size of the smallest. This substantiated the statements of various writers that the eggs of this species are laid at intervals of two or three days and that incubation begins as soon as the first egg is deposited. We had fully intended to photograph the little fellows, but when we removed them from the nest, they seemed so weak and frail, and showed such evident discomfort in the hot sun, that we lost heart and hurriedly replaced them in the nest without taking the coveted pictures.

Our fourth visit on June 16 was especially interesting. The youngsters had begun to take an active interest in life, and photographing them was rather strenuous work. The hot sun seemed to wilt them, unaccustomed as



The difference in size of the young is accounted for by the fact that the parent bird lays the eggs at intervals of two or three days, with a resulting irregularity in the time of hatching

they were to its rays after days spent in their dark retreat. They could keep their eyes open only a few moments at a time, and when exposed to the sun's rays for any length of time, they closed their eyes, opened their beaks, and panted violently, making anything but fast, instantaneous photography impossible. "Posing" all four at once kept us both busy. One or more were always moving, the larger ones crowding the smaller ones out of sight or focus; and one satisfactory negative was our total reward for this hard day's work. At this

stage of their development the soft, white down was being rapidly replaced by coarser, brown pinfeathers, giving the nestlings a decidedly bedraggled and unkempt appearance. They were able to hold up their heads but could stand erect on their feet only a few moments. The note was still an insignificant, soft little "cheep," although they were silent most of the time while being handled.

On June 23 the birds were fully one half the size of the parents; the general color was much more brownish (the

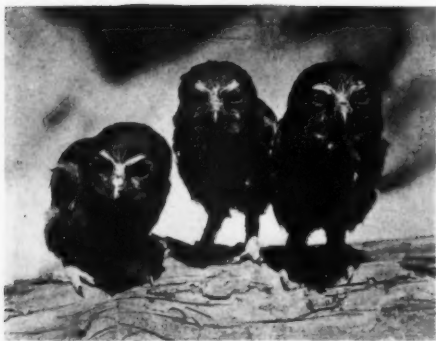


Indifferent to their appearance, conscious only of the discomforts of exposure to the sunlight, these nestlings exhibited little interest in the proceedings of the photographer and disarranged themselves as promptly as they were posed. Managing four of them, as in the picture at the top of the page, required both patience and skill. Both photographs were taken on June 16



NESTLINGS OF THE SAME BROOD

These pictures, taken on June 23, one week after those shown on the preceding page, indicate not only the progress made in the interval but also the difference in the feathering of the first-hatched members of the brood and their laggard brothers



By June 30 the nestlings had taken a long stride toward maturity and were very nearly as large as their mother

white down having almost disappeared), the wing coverts were well feathered, and the flight feathers were just beginning to grow.

On June 30 we were greatly surprised at the marked change in their appearance. The white down had entirely disappeared; the wings and tail, while short, were fully feathered out; the prominent, light-colored "V" between the eyes was very conspicuous; the entire plumage was of pure chocolate color (altogether different from the color and markings of the parent); and the birds were almost as large as their mother. This was the stage of their growth we had been waiting for, so we placed them in a roomy box and carried them triumphantly home where they could be more closely studied.

On each of our trips we were greeted by the parent bird at the entrance of her nest and, while she did not exhibit any evidence of fear or excitement, it was plain that she did not relish our company and she left the nest a little sooner at each succeeding visit.

While we had the young ones out of the nest, she made no demonstration, although a careful search would usually reveal her in a shady spot near by intently watching us. So far as we could tell, we did not see the male bird at all. In any event we did not see both parents at the same time. After our first visit we were unable to approach the old bird closer than fifteen or twenty feet.

The only evidence of food about the nest were a few remains of mice, and we were unable to find any disgorged "owl pellets," which are the best index of an owl's food. There were no bird feathers about the nest and in fact no feathers at all in the nest cavity, although the entire abdomen and part of the breast of the female were entirely devoid of feathers.

The young birds, from beginning to end, showed no fear of us whatever and did not make any attempt to escape, even when fully fledged. They were very awkward, often falling off the

branches where we placed them and (until well grown) frequently tipping forward on to their beaks in a most ludicrous fashion. We handled them freely with bare hands and they made no attempt to use their strong, sharp claws which, even in the very early stages would have made formidable weapons, had the birds been inclined to use them upon us. The attitude of both young and adult, except in rare instances, was decidedly lacking in animation, spirit, and aggressiveness, in sharp contrast to that of other species of owls. They seemed rather to enjoy gentle stroking and would cuddle down in the palm of one's hand in a very confiding manner. As the young grew older, they were much less affected by heat and bright light; and the parent to our amazement would gaze with unblinking eyes directly into the sun's rays reflected from a mirror (used to throw light upon the object) for minutes at a time. During all of our visits we did not hear the parent utter a sound, and unfortunately we were unable to spend a night near the nest to enjoy their peculiar night "song" from which their name is derived.

The young birds from the first took kindly to their captivity, showing comparatively little fear, and maintaining their characteristic lack of animation. They readily accepted a change of diet from the mice they had undoubtedly subsisted upon while in the nest to one of small bits of beef and an occasional meal of liver. Curiously enough they persistently refused to touch mutton.

During their entire captivity, which extended through the summer and well into the fall, they were almost entirely silent. During the day they retired to the shady spots in their large flying-cage and slept cuddled close together, but at night they showed more activity, hopping or flying about the cage, very much awake and alert. The difference in size noted before continued and the larger birds were apparently stronger and more healthy than the smaller ones.



This captive bird illustrates the changes in plumage corresponding with increase in age. The least advanced stage is represented by the topmost photograph



Two of the captive birds. The one bird has developed more rapidly in size, the other in plumage

Their development from the juvenile to the adult plumage was also more rapid and they exhibited more animation. The smallest (youngest) bird of the brood was a weakling and after a few weeks of captivity began to fail in strength and finally died.

While the birds were never very wild, they did not become very tame and, as they grew older, showed an inclination to use their sharp claws when handled although not with the ferocity exhibited by captive owls of other species. They did, however, apparently enjoy having the backs of their heads gently stroked, and would sit quietly in the hand while being petted. On the whole they proved

to be unusually attractive, interesting, and cleanly pets, and we regretted the day when we finally decided that no more information was to be secured by their continued captivity and that the time for their liberation had come.

Their presence in our family circle prompted us to read all the available literature regarding the species and we found delightful descriptions of their habits in Bendire's *Life Histories of North American Birds* and Fisher's *Hawks and Owls of the United States*.

Fisher, quoting Brewster, gives an interesting account of the operation of disgorging the pellets, which he observed in a young specimen in his possession:

"The owl would gape several times, then the head would be violently shaken sideways, and finally the pellet, coated with mucus, would shoot forth, frequently falling several inches in front of the spot where the bird was sitting. After it was all over the little fellow assumed an expression of relief and contentment which was very comical."

Both writers agree that the birds are easily captured during the day. Fisher, quoting Ridgway, says: "But a single individual of this pretty little owl was met with; this one was captured alive by Mr. O. L. Palmer, of our party, who found it asleep and *placed his hat over it*." Bendire says: "Each winter one or more specimens were brought to me alive by some of my men, who found them sitting in the shrubbery bordering a little creek directly in rear of their quarters, where they usually allowed themselves to be taken without making any effort to escape. I thought at first that they were possibly starved, and on that account too weak to fly, but on examination found them mostly in good condition and fairly fat. Just before and during the mating season these little owls are quite lively; their peculiar whistle can be heard in almost any suitable wood and one may by imitating it often decoy them within reach of the hand. Upon one occasion, when my assistant was imitating one, it alighted on the fur cap of a friend who stood near him. They are not at all suspicious and I have more than once stroked one with my hand as it was roosting sleepily in some bush or tree."

Fisher says: "The mortality which sometimes occurs among this species in winter is difficult to account for. Specimens which show no signs of violence, though somewhat emaciated, are found on barn floors, under trees, or along fences. That cold has anything to do with killing this hardy little owl is not to be supposed, for such accidents occur more often towards the southern limit of its range; and why should it starve in localities where food abounds, as

about Washington, where most of the specimens secured have been picked up dead?"

That the diet of these owls is not entirely restricted to mice is borne out by the amazing statement of Mr. George Lawrence Nicholas, who says: "While hunting in a pine wood near this town (Summit, New Jersey), I obtained an Acadian (saw-whet) owl. Upon dissecting it I found that its stomach contained a flying squirrel, which had been *swallowed whole* and but slightly digested." Dr. Merriam mentions the following, which occurred at Point de Monts, Canada: "In winter Mr. Comeau once saw one of these little owls fly from within the carcass of a great northern hare which had been caught in a snare. The owl had eaten away the abdomen and was at work within the thoracic cavity when frightened away."

Fisher states that while the species is not migratory, it is more or less an irregular wanderer in its search for food during the fall and winter, and that it may be quite common in a locality and then not be seen there again for several years.

Two interesting variations from the usual nesting site in a cavity are recorded by Captain Bendire, who cites one found in a deserted nest of the black-crowned night heron and another in an old squirrel's nest. Fisher states that: "Mr. W. Perham, of Tyngsboro, Mass., was very successful in inducing this owl to build in nests which he put up in different parts of the forest. These 'nests' were sections of hollow limbs closed at the ends, with an entrance hole made in the side."

A word about our photographic equipment may be of interest. As is invariably the case in bird photography, the most satisfactory results were secured with a four by five graflex camera fitted with a ten-inch lens for close work and a twenty-inch lens for distance pictures. However, several "posed" pictures of the young birds were taken with an ordinary type of postcard-size folding

camera, with a six and one half inch anastigmat lens and rapid shutter.

One of our most indispensable adjuncts, aside from the cameras, was a large mirror fitted upon a tripod with an adjustable head, which permitted us to throw a beam of brilliant light upon the object to be photographed when it was in shadow, and thus made possible fast exposures where a time exposure would have shown movement. It kept one of us busy adjusting the tripod head to compensate for the movement of the sun, but the results were worth the effort, for through the use of the reflecting mirror we secured several pictures that would have been photographic impossibilities without it.

Another very useful appliance was a huge, specially designed tripod with legs nearly twelve feet long, which enabled us to elevate the camera to otherwise inaccessible positions.

Our twenty-inch lens made possible

good-sized images of the owl at a distance of ten or twelve feet, but the lenses of shorter focus required exposures at a distance of from two to four feet. Additions to the above equipment were a small keyhole saw for cutting into the cavity, nails to reattach the part removed, a very generous supply of plates, and an inexhaustible (?) amount of patience and good humor.

Our experiences with these little owls in addition to the information we gained concerning them, taught us many things: just how long we could hold our tempers; how many tons our paraphernalia weighed after we had packed it up the steep hillside; how much stifling heat a human being could endure under a hot focusing cloth, and how good a lunch could taste after our work was over. Yet in spite of it all we look eagerly forward to another intimate glimpse into the home life of our new-found friends—the saw-whets.



A captive saw-whet (on the right) photographed with an adult Rocky Mountain screech owl (on the left) to illustrate differences in size and markings and the absence in the one owl, the presence in the other, of the ear tufts

WHY PALÆONTOLOGY?

BY

W. D. MATTHEW

IN AN institution as large as the American Museum, where each department is giving devoted attention to its own tasks and aims, there is need, in the interest of coördination, of bringing to the attention of each department the purposes and accomplishments of its fellow departments. With this end in view there were arranged during the past year a series of informal addresses delivered in turn by the several department heads before the assembled Museum staff. These addresses accomplished their purpose admirably, making clear as they did, the varied scope and meaning of the Museum's different fields of endeavor. Feeling that a larger audience than that originally addressed may be interested in having an opportunity to judge of the character of these informal talks, *NATURAL HISTORY* prints below that of the curator of vertebrate palæontology.

WHEN Director Lucas invited me to take part in this series of more or less informal talks, he told me my subject would be "Why Palæontology?" What are we trying to do in the department of vertebrate palæontology, and why is it worth doing? That reminded me of a rhyme that I learned when I was a small boy:

There once was an Eminent Elephant
Who invented a thing called a Telephant.
When asked "What's it for?"
He replied: "Such a bore
To be pestered with questions irrelevant."

Now I think there are a good many people who are inclined to ask that question and, in spite of the eminent authority I have cited, they have a good right to ask it. It is a question that ought to be asked and answered. And if the answer isn't satisfactory, we have no business to be wasting our time on it. What's the use of collecting and studying fossils, and why should this public institution be devoting so much money and space to them?

I may as well say in the first place that, from a purely materialistic point of view, palæontology isn't of much direct use, if any. Chemistry, physics, economic geology, the agricultural sciences, and many others are decidedly practical subjects. They lead directly to inventions and discoveries that improve our methods or increase our output or save labor, in manufactures, in mining,

or in agriculture. They are applied sciences from this point of view, and their use to civilization is obvious, as they are directly responsible for its great advances in material comfort and prosperity.

But there is something more than this to civilization, something more to be desired in the world than luxury and short hours of labor. Knowledge and understanding, the appreciation of the beautiful both in nature and art, are things worth while for themselves alone, even though they do not increase our income or decrease our hours of labor. Everybody reads the newspapers. Why? Certainly not one in ten thousand reads them solely for business reasons. We read them because we want to know and understand what is going on about us. We read books mostly for the same reason, because we want to know. The newspapers maintain a vast organization for the purpose of gathering news, of getting together evidence of what is going on in the world, and presenting it to their readers. We, in our smaller way, are gathering together evidence as to what went on in the world in past ages and presenting it before our visitors, because they want to know about it. If anybody demands "Why palæontology?" I may answer "Why the newspapers?" They do not need to apologize for their existence, and neither does palæontology. What we are trying to do is to get together all the evidence we can bearing on the past history of life on the earth, and of vertebrate life in particular. It is a most interesting history, varied and

changeable, with many sensational aspects and episodes, and through it all runs the silver thread of evolution and adaptation, uniting all the scattered data into a continuous historic record. The fossils are our documents, and are to be treasured and preserved and studied as such, and the first and fundamental object of a museum is to take proper care of its records, the second and larger task is to interpret them and show people what they mean and what they prove. We are not collecting curios, we are teaching geologic history.

This history, of course, is on a very different scale from human history. It deals in æons, not in centuries, in geologic ages that cover millions rather than hundreds of years. But in either case the history has to trace the evolution of races, their development and adaptation to their environment, their rise and growth and extinction and replacement by others, the sequence of cause and effect in the events that are recorded; and in the end to interpret and understand what exists today through our knowledge of what has happened in the past.

In the history of the vertebrates we deal chiefly with five great geologic eras, the Age of Fishes, the Age of Amphibians, the Age of Reptiles, the Age of Mammals, and the Age of Man. The last three are represented by the three exhibition halls in which our collections are placed; the first two will be adequately installed later on, but at present we have to crowd them into the little tower room and a corner of the reptile hall. These represent the five principal stages in the history of vertebrate life, beginning with the fishes of early geologic ages, then the amphibians of the coal era, then the dinosaurs and other giant reptiles of the Mesozoic period, next the evolution of the mammals during the Tertiary period, and finally the dominance of man during the latest geologic period, or Quaternary.

The Age of Fishes is marked by the dominance of the fishes as the principal known type of vertebrate life. These, of

course, lived in the water, and we know very little about the terrestrial life of that period. I think it is rather rash to assume that there was not any, as Mr. H. G. Wells does in the sketch of geologic history that opens his *Outline of History*. We do not know.

The Age of Amphibians is characterized by numerous kinds of amphibians and primitive reptiles. The amphibians began life as tadpoles, breathing by gills and living in the water, and when full grown, came out on the land and breathed by lungs. The reptiles breathed air by lungs and lived upon the land. These amphibians and reptiles were the dominant animals, the highest types of vertebrate life of their time. Many of them were strange in form, and of fairly large size, and nearly all preserved a good many features from their fish ancestry that have been lost by the later reptiles and mammals. We have two important collections of the animals of this period: the skeletons of *Eryops* and *Naosaurus* and *Dimetrodon* and *Diadectes* from Texas and the *Moschops* and *Endothiodon* from South Africa.

The Age of Reptiles is especially distinguished by the dinosaurs, which were the great land animals of their time, and by the ichthyosaurs and plesiosaurs and mosasaurs, great sea-reptiles, and the pterodactyls, or flying reptiles. There was a great variety of dinosaurs, biped and quadruped, armored and unarmored, herbivorous and carnivorous, and they are splendidly represented in our exhibits, so much so that they have crowded almost everything else out of the reptile hall and encroached a good deal on the mammal hall beyond. The *Brontosaurus* and *Allosaurus* and two smaller kinds represent the middle period of the Age of Reptiles; the *Tyrannosaurus*, the *Trachodon* group and about a dozen other skeletons represent its later development.

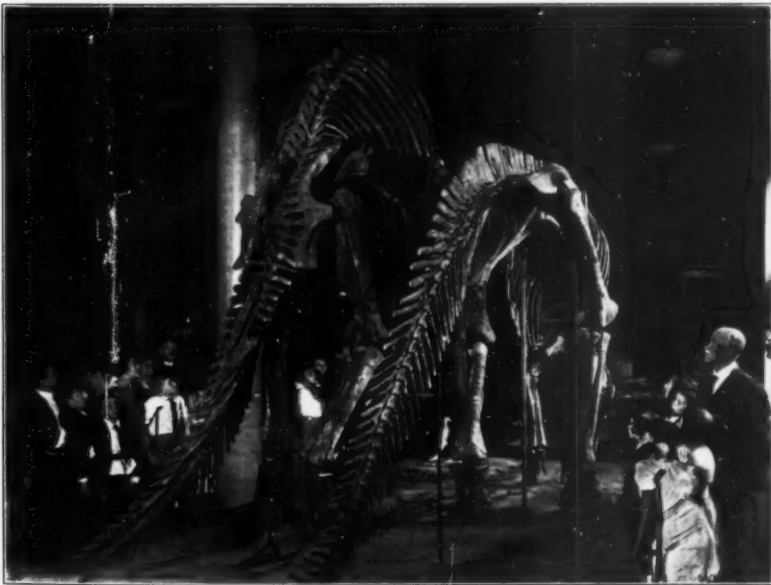
The marine reptiles are very scantily represented, as compared with what could be done, chiefly because of lack of space, but there are skeletons of three kinds,

ichthyosaurs, plesiosaurs, and mosasaurs on exhibition, and the fine *Pteranodon* skeleton and a tiny little pterodactyl represent the flying reptiles.

The animals of the Age of Reptiles are so remarkable and different from anything familiar to us that they strike the imagination as creatures of another world. In the Age of Mammals, on the other hand, the prominent feature is the evolution of the various types of modern animals from primitive ancestors. This is the keynote of the hall, and the evolution of the horse is the most striking and best arranged illustration of it. The record is also well shown, however, in various other races,—the camels, rhinoceroses, the extinct titanotheres, and others.

The last and finest of our exhibition halls represents the Age of Man. The most impressive feature in it is the series of mural paintings by Charles R. Knight representing faunal life scenes of this period, and showing both primitive

types of man and the animals that were contemporary with him in various quarters of the globe,—the immediate predecessors, and near relatives for the most part, of modern animals. The central exhibit in the hall shows what is actually known of fossil remains of primitive man with reconstructions and charts to interpret and explain it. The fossil remains as yet are few and fragmentary, but we hope that in the future our records may be more complete. On the north side are arranged the mammoths and mastodons of the northern continents, and on the south side the ground sloths and glyptodons and other South American giant animals. These will be supplemented later with other characteristic types of the magnificent fauna that lived in all regions of the world during the Age of Man—the cave-bear and the Irish deer, the *Diprotodon* of Australia, and the great variety of animals which have been found at Rancho-la-Brea near Los Angeles.



A section of the hall of dinosaurs, showing an interested group of crippled children gazing upon creatures that are impressive not only from the standpoint of size but also because of the vast period of time that separates them from the present.



A PRIZE-WINNING EXHIBIT

Jamaica High School was awarded first place in an eagerly contested floral competition. Initiative, ingenuity, and an ardent school spirit were required to bring together flowers and products of such variety and attractiveness. Underlying the gayety of the setting were real lessons in science. Boxes of seeds were arranged in a manner to convey instruction, and the flowers and vegetables were carefully identified and labeled with the scientific and family names as well as with their common designations.

JUNIOR HORTICULTURISTS OF GREATER NEW YORK

A FLOWER SHOW AT THE AMERICAN MUSEUM IN WHICH PUPILS OF THE CITY WERE INTERESTED COMPETITORS

BY

RUTH CROSBY NOBLE *

TO THOSE who believed that the high-school students of New York City could not derive pleasure and benefit from nature study, the Flower Show held at the American Museum on September 30 and October 1 and 2 was a convincing refutation. The eagerness and pride illuminating the faces of the boys and girls as they brought in their contributions, the enthusiasm with which they arranged their exhibits, and their genuine interest to know of the things before them proved conclusively that nature study does have a place even in a city as built up and well-nigh gardenless as is New York.

The Show was planned by the New York Association of High School Biology Teachers for two purposes: to increase the interest in nature among the children themselves, and to give the public an opportunity of seeing what the schools had accomplished in the way of practical nature study. Aside from this was the desire, through displays of artistic posters announcing the Flower Show and musical recitals by school orchestras, to establish among the departments of art, music, and biology, a common object of endeavor. The plan was confined at first to the high schools of Greater New York. The committee in charge later decided to invite the coöperation of other organizations and were more than gratified by the splendid response which they received. The exhibits of the National Plant, Flower, and Fruit Guild, the State Institute of Applied Agriculture at Farmingdale, the School Garden Association, and the Brooklyn Botanic Garden proved to be valuable and striking additions to those of the high schools.

The afternoon before the formal opening, Memorial Hall and the Hall of the Eastern Indians were flanked with dull-looking tables over which were scattered long rolls of paper and hundreds of empty receptacles. Cut flowers, vegetables, potted plants, flowerless plants, water flowers, and seed collections were gradually brought in by eager school children, beaming with pride over their own garden produce or over the gifts of their friends. Teachers and pupils energetically labelled the material, arranged it in the proper booths, and soon had the halls transformed.

Those who came to the opening of the Flower Show Friday afternoon faced, as they stepped into Memorial Hall, the gay display of the outside organizations. There was the central exhibit planned by the National Plant, Flower, and Fruit Guild,—an association organized to distribute among the city hospitals and tenement districts the flowers, fruits, and jellies which are sent in from rural branches. Community gardens are also an important feature of the work of this association. To the right of the entrance were photographs and pamphlets, as well as garden produce, shown by the State Institute of Applied Agriculture at Farmingdale. Roosevelt said of this school, "Among all valuable agricultural colleges of the nation, the institution at Farmingdale stands out, because it doesn't only teach farming but, to an extent equalled nowhere else, it *creates farmers*." At the left stood one of the most appealing of all the exhibits,—the flowers and vegetables harvested by grammar school "farm hands" in the tiny plots of the School Garden Association. Last year more than thirty acres in Greater New

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York were cultivated under the supervision of this Association and the produce harvested by the 3700 children enrolled was valued at \$100 a day.

A picturesque background to these groups was formed by screens of posters which had been submitted by the high school art students for the competition. On Saturday the posters were judged by Mrs. Charles R. Lamb of Mosaic Cornell Chapel and Miss Katherine Lamb of the Institute of Design at Cooper Union, and first place was given to one of the girls of the art department of Washington Irving High School. From behind the screens strains of music rang through the formal halls of the Museum,—the high school orchestras were also contributing to the success of the Show.

An especially interesting exhibit of ferns and flowerless plants was arranged just west of Memorial Hall under the auspices of the Brooklyn Botanic Garden. Near by was a case of colored prints portraying the wild flowers of New York, loaned by the State Botanist, Mr. Homer D. House.

The Hall of the Eastern Indians was given over to the exhibits of the competing high schools. Each alcove was backed by a flaring high school banner and transformed into a thing of beauty and color with flowers, plants, fruits, and seeds, procured from all possible sources. Some of the specimens were brought by the boys and girls from their own gardens or from the gardens of their parents. Others were contributed by friends. The children who lived in the more crowded districts hiked into the country and returned with armfuls of fruits and nuts, flowers and shrubs. Still other material came from florists and seed dealers. Each plant was labeled with a card, upon which was indicated with great care and accuracy the scientific name, the family name of the plant, and the name of the school exhibiting it. Miss Ellen Eddy Shaw and Mr. Montague Free—both of the



A harvest of carrots of which any farmer might be proud



The school gardens of Greater New York offer a means of escape from the high cost of living. Market prices of vegetables as wholesome and fresh as these are prohibitive for many people

Brooklyn Botanic Garden—judged the exhibits from the point of view of variety, quality, and arrangement. First place was given Jamaica High, with Bay Ridge coming second, and Newtown third. In addition to the contest between the high schools, there was the contest within the schools for the best individual contributions. Seventeen prominent publishers lent their encouragement by donating books as prizes. Seeds were also presented by H. Burpee and Company for the same purpose.

On Friday evening the Visual Instruction Committee arranged an exhibition of motion pictures of scientific interest, photographed by Mr. Charles F. Herm, formerly of the American Museum. Addresses were made by Dr. Ernest L. Crandall, director of visual instruction, and by Dr. Maximilian Grossman, head of biology in the high schools. Additional motion pictures were shown Saturday afternoon and a

lecture on dahlias was given Saturday evening by Dr. Howe of the New York Botanical Garden, Bronx Park.

The Flower Show was the first of its kind ever held. Great credit is due not only to Superintendent Meleny, in charge of the high schools, who gave his sanction to the project, but also to the efficient committee, headed by Miss Rosemary Mullen, which was in immediate charge of the arrangements. Not only was interest in botany stimulated, but also that love for growing things which is inherent in all boys and girls. Their store of facts was enriched, they were given an object lesson in scientific accuracy, and their appreciation was perceptibly broadened. Incidentally they had placed before them a worth-while diversion for their energies. It was healthful and attractive work, offering opportunity for that refreshing out-of-doors exercise of which city children are always in need.



Community gardens are a feature of the work of the National Plant, Flower, and Fruit Guild. The children's garden maintained by the Guild at Avenue A and 65th Street is sufficiently spacious to permit 600 children to have plots for cultivation



Various methods of attack were employed in the campaign waged in New Jersey against the gypsy moth. Before the potential destroyers of foliage had an opportunity to emerge from the egg, vast numbers of them were rendered harmless through creosoting of the egg clusters. During the caterpillar season twelve machines of the type shown in the illustration above were operated in the infested territory. The foliage of parts of the Watchung Mountains was sprayed, the insecticide being forced through a half mile of hose laid on the mountain-side. In treating small trees and low growth, a spreader was attached to the nozzle, causing a fan-shaped spray to be delivered

THE GYPSY MOTH IN NEW JERSEY

HOW AN INSECT MENACE HAS BEEN CHECKED

ONE of the most pernicious of insect immigrants from the Old World and one so tenacious that the efforts of the federal government as well as those of several of our states have as yet failed to accomplish its extermination, is the gypsy moth (*Porth-*

tria dispar). Accidentally liberated in Massachusetts in the late sixties, it has to its discredit more than half a century of destructive activity in this country. Its ravages would have been even more destructive except for the unremitting labors, backed by lavish sums, that

have been devoted to its control. Until recently the campaign waged against this insect had succeeded in keeping it confined to New England, and the hope was cherished that it would not extend beyond this area. Very disquieting, therefore, was the discovery, made now well over a year and a half ago, that it had gained a firm foothold in New Jersey. It has been surmised that it reached that state in a shipment of blue spruces imported from Holland and planted on the Duke estate in Somerville during 1911. To the prompt action of the United States Bureau of Entomology in placing a force of scouts in the field, and to the foresight of the state legislature in voting funds, supplemented later by an appropriation made by Congress, is due in no small measure the fact that the havoc wrought in New Jersey has not been greater. Indeed, so effective have been the preventive measures that it is reported that less than a year after the inauguration of the campaign, gypsy moth caterpillars are difficult to find, even in the areas most heavily infested. Reference to the progress of the work in New Jersey has been made from time to time in *NATURAL HISTORY*; these earlier reports can now be supplemented by a further statement of accomplishment.

The magnitude of the task is indicated by the fact that no less than 403 square miles were found to be infested, of which 175 were generally infested, the rest lightly. About most of this territory a wide border area was examined and found free of traces of the gypsy moth. The infestation was heavy in Hillsboro, where more than 3,000,000 egg clusters were creosoted. At Mendham, where, as a result of the scouting work, 1400 egg clusters were found in old orchards and grounds near by, many of the infested trees were cut down and

burned, the owners coöperating. In the case of trees not so destroyed, the egg masses were creosoted and, furthermore, a large safety area was sprayed.

In addition to scouting and the destruction of egg clusters, extensive spraying operations were engaged in over the entire territory. More than 2400 acres were so treated, exclusive of miscellaneous growth along fences, river banks, etc. Seventy-five tons of arsenate of lead were used, and approximately 2,700,000 gallons of spray applied. Also, approximately 20,000 trees were banded with sticky material and 15,000 with burlap.

A state quarantine, administered in coöperation with the Federal Horticultural Board, has been placed on the infested territory, as well as upon the small outlying areas where only a few egg clusters were found. This quarantine furnishes adequate authority to prevent the shipment of infested stock to other parts. Nurseries and other centers of distribution have been inspected, some several times, and every precaution has been taken to prevent the shipment of material carrying egg clusters or larvæ.

So satisfactory have been the results that a spirit of over-confidence may easily be engendered in the public, with resulting failure adequately to support the continuation of the work. Not to recognize the fact that only by persistent, unrelaxed vigilance can this pest be permanently checked is to invite a repetition of the situation, or worse, that has happily been remedied. A comparatively small number of liberated insects sufficed for the colonization of large areas in New England; the comparatively insignificant remnant of the New Jersey infestation, if allowed to breed unchecked, may in a short time become a menace difficult to control.

NOTES

AFRICA

THE accomplishment of one of the major purposes of Mr. Carl Akeley's expedition into the African jungle, namely, the securing of a group of gorillas for an American Museum exhibit, is tersely announced by the explorer in a cablegram, dated December 10: "Five beauties. Male 360 pounds. Span 7 feet 8."

To appreciate the significance of this announcement, one must bear in mind that although so many of the larger animals of Africa have long been familiar to the world, it was not until 1846 that definite proof of the existence of the gorilla was furnished through the accidental discovery of a skull of this ape by the Rev. Dr. J. Leighton Wilson, a missionary.

Tales of the existence of such an animal had, however, drifted to civilized lands from time to time prior to this event. The earliest of these descriptions which may with some degree of probability be applied to the gorilla is that given by one Andrew Battell, who sojourned for a time among the Portuguese in Angola. It was printed in *Purchase His Pilgrimage* by Samuel Purchase, several successive editions of which appeared in the first quarter of the seventeenth century. In spite of the statements therein contained to the effect that the huge apes, or, as Battell calls them, pongoes, "will come and sit about the fire [made by natives]," and that "many times they fall upon the Elephants, which come to feed where they be, and so beate them with their clubbed fists, and pieces of wood, that they will runne roaring away from them," Battell's account is not lacking in touches which have inclined some to the belief that the creatures he writes about are actually what we today know as gorillas.

Relatively few specimens of the gorilla have been secured in the period that has elapsed since 1846 and contradictory statements regarding its alleged habits in the wild still await clarification. It was to study the living animal, in addition to securing a Museum group, that Mr. Akeley undertook his trip, and an evidence that this side of his work is meeting with success is the fact that he has actually come close enough to gorillas to photograph them.

ASIA

THE latest report of the Third Asiatic Expedition of the American Museum in coöperation with the American Asiatic Association and *Asia Magazine*, contains the reassuring news that Mr. Andrews returned successfully from an expedition for takin, a very rare mountain type related to the chamois, the serow, and our own Rocky Mountain goat. Mr. Andrews writes, October 31, 1921:

"I am on the train *en route* to Pekin after the trip into Shensi for takin. It was the hardest trip I've ever had—fearful work in the roughest mountains of China—and we came as close to having 'adventures' as I have ever come. There was a good bit of fighting going on about us and we ran squarely into a crowd of 200 brigands, but my medical kit came in very nicely; I patched up wounded men for an entire day, and they were very grateful. They treated us with the greatest courtesy and even gave us a guard of honor until we were out of the danger zone. It was an interesting little experience and proves my doctrine that understanding of the people avoids 'adventures.' We got the takin and a splendid lot of small mammals, many of which are certainly new to science."

A letter sent by Mr. Andrews from Pekin on November 11 throws further light on the exceptional difficulties attending the hunt for the takin:

"The takin were down in the thick bamboos on the summit of very rough peaks at an altitude of 12,000 feet, and it was heartbreaking work getting them. I shot a splendid cow and her calf. I have left two of my native hunters in the mountains to try to get a bull, for we were driven out by a heavy fall of snow. Moreover, we were almost exhausted, our food was entirely gone, and we were so badly battered up from falling among the rocks and the terrible work in the bamboos, that we had to have a respite. I have no doubt that my native hunters will get a bull and we will then have a very spectacular group."

"I have never beheld any animal so remarkable as the live takin. It is the reincarnation of the Golden Fleece. These Shensi takin are quite different from those of Szechwan, of which we have a mounted specimen in the Museum. They are bright golden yellow, and when seen among the green bamboos give a really startling effect."

A LETTER from Mr. Walter Granger to President Henry Fairfield Osborn of the American Museum reports on the progress of Mr. Granger's work in China, and like the letter from Mr. Andrews just quoted gives some idea of the difficulties of exploration in that much disturbed country. He says:

"I reached Wauhsien on September 8 after some delays and some interesting experiences due to the inter-Provincial warfare going on along the Yangtze. At Ichang we ran directly into fighting and found a good deal of entertainment in watching it, through field glasses, from the deck of our boat. After five days we got away from Ichang on an up-river boat, the 'Loong Mow,' and had a day and a half of some of the most remarkable scenery to be observed anywhere."

"The steamers do the gorge trip almost too quickly and the wonderful limestone cliffs are behind one before one has time fully to take them in. The proper way to see the gorges is by house boat in winter when the water is low."

"On our arrival at Wauhsien we were most cordially received by the Commissioner of Customs, Mr. C. G. C. Asker, who invited us to make our headquarters at his place. Mr. Andersson had been in correspondence with him and he was expecting us. This is only a very small foreign community and visitors are always welcome. The Standard Oil (2 men), the customs (3 men), the post office (1 man and wife), and one Protestant and one Catholic mission constitute the white population of the town.

"The country is reported fairly free of bandits just now. Most of them, in fact, have joined the Szechwan army and are either around Ichang or on their way there. This leaves things relatively peaceful here, but the population dreads the time, later in the fall or early winter, when these soldiers begin to drift back, looting as they make their way up-river. They seldom get any pay and have to live off the country, as it were.

"We are all well. The cool weather of fall is just setting in. There were no frosts here last winter, and work throughout the season is possible."

In his next letter Mr. Granger expects to report upon the results of the collecting trip to which this journey was preliminary.

AUSTRALIA

UNDER date of October 26, Mr. Harry C. Raven, the field representative of the American Museum in Australia, writes:

"I left Moseley's Ranch, in the mountains of northern New South Wales, on the fifth of September and went to Ebor for a few days. It was raining when we broke camp and rained for most of the following week or so. While at Ebor we were able to make use of the time by drying the specimens already prepared and in getting a few others from the gorges near the Ebor Falls. They included the wallaroo, *Macropus robustus*, and a wallaby, *Macropus ulabatus*. One of the females of the last-named species had a young one in her pouch. The young one was well developed and was certainly about ready to leave the pouch for good. We kept this young wallaby as a pet for two or three weeks and I was able to get some photographs of it.

"Next we made a camp at a place called Glen Ferneigh, or Cedar Log. At this camp two species of phalangiers, *Pseudochirus peregrinus* and *Trichosurus caninus*, were found to be quite common. The former was the more numerous and I collected a good series of it. The skins would probably have been in better condition had we obtained the animals a few weeks earlier; the spring weather had caused them to begin shedding their coats. Each of the greater number of females (and nearly all were females) had two naked young in the pouch. There were also two or three young of the *Trichosurus* procured from the pouches of the females of that species; in no case did a female have more than a single young one in the pouch. Besides the phalangiers, we found *Phascologale flavipes* with young in the pouch. At Moseley's Ranch, in

New South Wales, only the *Phascologale swainsoni* had young. At Glen Ferneigh we also secured two additional species of *Macropus*, namely, *thetidis* and what is probably *parryi*. Besides the specimens already mentioned, the only other new one added to the collection from this locality was a bat, which I believe to be a species of *Chalinolobus*. These bats were very numerous in some caves that we found beneath a waterfall, so we collected a large series of them."

SOUTH AMERICA

IN THE last issue brief allusion was made to the accident which cut short Mr. Cherrie's recent expedition to Ecuador. Fuller details are now available and deserve to be recorded if only for the light they shed on the personality of one who has worked indefatigably in the interests of the American Museum. The accident occurred on the morning of September 21, 1921, while Mr. Cherrie was out hunting in southwestern Ecuador, close to the Peruvian border. Both barrels of his gun, which was loaded with number eight shot, were discharged simultaneously into his forearm, severing the ulna.

A return to the coast was, under the circumstances, imperative. Accordingly, as soon as first-aid treatment, necessarily very rudimentary, had been administered and animals for the trip had been secured, a start was made for Santa Rosa, distant eighty-five miles, where Mr. Cherrie hoped to catch the weekly steamer for Guayaquil. So great was his pain that he was unable to ride on the level or downhill and consequently, the upgrades excepted, he walked all the way. The journey to Santa Rosa necessitated the ascent and descent of a mountain 8000 feet in height. Food that the invalid could retain was difficult to find and the natives he met naïvely asked, "Why eat anyway?" The last day of the three-day journey the party took the trail at midnight, in the hope of getting the boat that reached Santa Rosa at 11 A.M., but arrived three hours after the boat had left. Since Mr. Cherrie's life depended upon their catching this boat, they started after it in a canoe and by great good fortune overtook it at a port farther down the river at midnight, just fifteen minutes before it sailed. The last day, therefore, Mr. Cherrie was on the way for twenty-four hours. He did not sleep from the time of his accident until he boarded the steamer.

Guayaquil was reached at 1 P.M. on September 25. By that time his arm was the size of his leg and was so gangrenous that his life was despaired of. An operation was performed as soon as possible and the shattered sections of the ulna were removed. Under the care of an American physician, Dr. H. Parker, Mr. Cherrie's condition then began to improve and five weeks later, taking advantage of the return to this country of the American Health Officer resident in the

port of Guayaquil, Mr. Cherrie accompanied him to New York. He reached the American Museum in remarkably good condition when one considers all he had undergone. His wound was healing as rapidly as could be expected. An X-ray showed a probable regeneration of bone in the ulna which may eventually unite the severed ends. In short, every hope is entertained that in due time he will recover the use of his arm. Courage of rare quality was shown in proceeding in the face of obstacles so formidable. It would have been far easier to lie down on the trail and die than to keep under way. By fighting through, Mr. Cherrie again gave evidence of those sterling traits of character that have made him beloved not only by Colonel Roosevelt, with whom he was associated in the exploration of the River of Doubt, but also by all who have come in contact with him.

SINCE its foundation in 1916 the New York Zoological Society's Tropical Research Station at Kartabo, British Guiana, of which Mr. William Beebe is the director, has had as its main object, the observation of living organisms in their natural environment. No less than ninety-three contributions have already been published from the Station, eighty-nine of which are scientific papers and magazine articles, the remaining four being books, three from the pen of Mr. Beebe and one from that of Mr. Paul G. Howes. The New York Zoological Park, in which Mr. Beebe is honorary curator of birds, the New York Aquarium, and the American Museum have benefited from the activities of the Station. To the Zoological Park have been shipped live specimens, ranging from the silky anteater (*Cyclopes didactylus didactylus*) to an eight-foot bushmaster (*Lachesis mutus*); the Aquarium has acquired, among other fishes, electric eels (*Electrophorus electricus*) and Perai (*Pygocentrus niger*). The American Museum is indebted to the Tropical Research Station for a total of 521 mammals, belonging to fifty-six species and subspecies. These specimens are of particular value because, in addition to the skins, there are many skeletons. Many of these mammals are of especial importance because of the fact that a number of the South American types of the great eighteenth-century naturalist, Linnæus, were obtained from this general region. A report of the "Mammals Collected by William Beebe at the British Guiana Tropical Research Station," covering this acquisition and written by Mr. H. E. Anthony, curator of the mammals of the Western Hemisphere, American Museum, has just been published in *Zoologica*. Several hundred reptiles, amphibians, and fish have been collected at the Station, placed in alcohol, labeled, and shipped to the American Museum.

An exhibition of water colors of tropical animal life by Miss Isabelle Cooper, of the Tropical

Research Station, was on view in the west assembly hall of the American Museum from January 5 to January 20. The exhibition was held under the auspices of the Ladies' Auxiliary of the New York Zoological Society, of which Mrs. Henry Fairfield Osborn is the chairman.

ANTHROPOLOGY

DURING the last week in October Mr. N. C. Nelson, associate curator of North American archaeology in the American Museum, made his first and only field trip this year, to examine an alleged "Indian workshop" in the headwater region of the Lehigh Valley, northeastern Pennsylvania. His informant, Mr. Max Schrabisch of Paterson, New Jersey, accompanied him and they made their headquarters eight miles from White Haven on the farm of Mr. Calvin D. Dotter. It is on this property that the Indian site is located. The workshop in question turned out to be only a small one and might be designated more exactly as a temporary camping place. It is situated in a slight hollow of a broad, elevated mountain plateau, which until recently was virgin forest and is still largely covered with second growth. The particular attraction of the spot was a group of springs, furnishing a permanent water supply, and it is reasonable to suppose that Indian hunters and berry pickers occasionally made camp here and that the hunters during their stay spent some time at chipping spear and arrow points. At any rate, some three hundred points and numerous small chips have been unearthed during the past year from the surface soil, mostly in the immediate vicinity of the springs but scattering out thinly over an area covering several acres. Protracted search and excavation, however, revealed, on the one hand, neither blocks nor blanks of raw chipping materials that would indicate that the place was a true workshop; and, on the other hand, no other forms of implements or of pottery such as would be expected at a regular village site. The elevation, moreover, is too high to permit maize properly to mature and it is, therefore, improbable that a permanent settlement was established.

During the stay, Mr. Schrabisch personally investigated a rock-shelter in the cañon of the Lehigh River, about two miles to the north, where he found evidence of occupation in the shape of net sinkers, chipped points, broken pottery, and fragmentary animal bones. Representative samples of everything found were brought to the Museum.

CLARENCE LEONARD HAY, research associate in Mexican and Central American archaeology, has been appointed an American Museum Fellow, to represent the Museum in the Interna-

tional School of American Archaeology and Ethnology in Mexico. This school is designed primarily as a research center for mature students; fellowships are maintained in it by several American institutions of learning. Mr. Hay, who is on the point of leaving for the southern republic, will take an active part in the investigations and instruction carried on by the school. In company with Dr. Alfred V. Kidder of Phillips Academy, Andover, he will make an archaeological reconnaissance of the region lying between Mexico City and the Rio Grande, with a view to studying the pre-Pueblo culture of that area.

ENTOMOLOGY

A UNIQUE exhibit is being installed in the railing cases of the third floor, east wing, of the American Museum. It will show different kinds of insects that were actually found in the small yard (75 x 200 ft.) of a residence in the center of a suburban village. Dr. Frank E. Lutz, curator of entomology, is unwilling to commit himself at present as to the number of species beyond saying that there are "more than five hundred." One of the fascinations of entomology is, that, in spite of the vast number of species already known, discoveries can still be made at our very doors, as this collection well illustrates. A number of the species in it have not hitherto been recorded from the state in which the suburban yard is situated, namely, New Jersey, although that state is the best known, entomologically, of any of our states. Furthermore, so much still remains to be discovered concerning insects that the life histories of more than half of the species found in this suburban yard are unknown. On what do the young feed; where do they pupate; how is the winter passed? These are a few of the puzzling questions that still await the investigator.

MR. F. E. WATSON, assistant in Lepidoptera, American Museum, is now in Hayti, continuing the American Museum's entomological survey of the West Indies. The expenses of this expedition are being defrayed by Mr. B. Preston Clark, himself an authority on the moths of the family Sphingidæ and possessor of an unrivalled collection of these insects. Mr. Clark also met the expenses of Mr. Watson's expeditions to Santo Domingo and Jamaica. Hispaniola, the island composed of Santo Domingo and Hayti, is particularly interesting because the relatively large extent of wild land there still harbors ancient and unique forms of life. The island is interesting also because it is the type locality of a large number of species of insects that were described in the early days, some of which have not been taken since.

HERPETOLOGY

AN AFRICAN land turtle, *Testudo loveridgii*, is the only known example of a reptile which in the adult stage lacks ribs. As the carapace, or shell, of turtles consists to a large extent of the ribs, it is not surprising to learn that in the adult stage this turtle lacks a shell, which is perhaps the principal element in any mental image we form of a turtle. Not in all of its stages is this turtle, which is confined to a rather limited area of Tanganyika Territory (German East Africa), devoid of a bony protection. In fact, at a certain stage the young have ribs with platelike ossifications lying on top of them, and resemble in this respect, as in several others, the corresponding stage of the turtle *Testudo pardalis* or *græca*. There is a progressive degeneration of the bony structure as *loveridgii* approaches the adult stage.

There is a turtle, *Testudo tornieri*, that represents with respect to the carapace an intermediate stage between the turtle herein described and the other members of the genus *Testudo*.

The flat shape of the turtle, *Testudo loveridgii*, is another peculiarity deserving emphasis. Almost all land turtles incline to the dome shape, many conspicuously so. The flat shape is more characteristic of the aquatic species. Yet here we have a land turtle that is excessively flat, more so than any of the aquatic members of the family Testudinidæ.

Three specimens of this remarkable turtle have recently reached the department of herpetology, American Museum, having been supplied through the courtesy of Mr. Arthur Loveridge, after whom the species has been named. One of these specimens represents the early stage, in which there are evidences of ossification; the second, an intermediate stage; the third, the soft-backed adult reptile, which is six inches in length.

What explanation can be given of the peculiarity mentioned? What function, if any, does this apparent degeneration serve? Why should the adult be deprived of a shell—which one would consider a character of no little value in the struggle for existence—in which the soft parts of the creature can take refuge when enemies approach? The sole advantage seems to be that, unencumbered by a bony burden, the turtle is able quickly to seek shelter amid stones or under them, as do lizards and serpents. The region inhabited by this turtle is arid, sandy, and stony. The vegetation is of the spiny kind. Mr. Loveridge, who has observed the turtle in life, has been cited to the effect that it has the ability of elevating, and in turn, of lowering the back, regulating these actions through its lungs and that thereby it is enabled to penetrate into the crevices of rocks and amid stones from which it is dislodged only with great difficulty. There are lizards, especially of the genus *Sauromalus*,



Picturesque rock formation in the tidal zone just below the Harpswell Laboratory. Formations of this kind are characteristic of Mount Desert Island

that wedge themselves into the crevices of rocks they inhabit by inflating the body in much the same way.

LOWER INVERTEBRATES

MR. ROY W. MINER, associate curator of lower invertebrates, spent part of the month of September on Mt. Desert Island, where he visited the newly established Weir Mitchell Station of the Harpswell Laboratory. Through the courtesy of the director, Prof. Ulric Dahlgren, and other members of the laboratory staff, Mr. Miner was enabled to examine the possibilities of the island as a site for future studies of the marine invertebrates characteristic of the rocky coast, from the viewpoints of exhibition work and scientific, ecological investigations. Mt. Desert Island is unusually diversified for an island of its size. Though only about fifteen miles long and twelve miles wide, it possesses eight mountain peaks from 1000 to 1500 feet in height, and many others of smaller elevation. There are several beautiful mountain lakes and the only typical "Norwegian" fiord on the American coast. The latter extends ten miles into the body of the island. The mountainous parts of the island are largely comprised within the limits of the new Mt. Desert National Park, obtained for the government through the activ-

ity of the Wild Gardens of Arcadia Association, of which Mr. George B. Dorr is president. The coasts of the island are bold and rocky, with here and there typical examples of sandy beach or mud flat. Huge caverns, carved by wave action, overarch sea pools where at low tide may be seen displayed beautifully tinted sea anemones, sponges, corallines, and other marine invertebrates in great abundance. The new laboratory, situated at Salisbury Cove village on the northern shore of the island, about six miles from Bar Harbor, stands on a picturesque promontory between two sheltered coves. The tide rises here a distance of twelve feet. The animal and plant life is profuse, not only in the shallow waters but in the deeper channels which run close to the shore in many places, affording unusual opportunities for dredging. The flora of the island is as distinctive as the fauna, boreal forms growing side by side with plants characteristic of more southern climes. The alpine *Empetrum*, generally found at high altitudes, here grows just above the tide limit.

During his stay Mr. Miner made collections at ten different points in ten days, and took many photographs. He then visited the Marine Biological Laboratory at Woods Hole, where he was joined by Mr. W. H. Southwick, the artist of his modeling staff, and with the cooperation of the laboratory officials, obtained additional

data for the Gay Head Sound bottom group now in an advanced stage of construction.

IN THE July-August issue of NATURAL HISTORY the capture of the large squid (*Sthenoteuthis pteropus*), which was washed aboard the steamship "Caronia," was reported as the third record of the capture of this species. A letter has recently been received from Dr. James Ritchie, keeper of the natural history department of the Royal Scottish Museum of Edinburgh, stating that the species is by no means so rare in the neighborhood of the British Isles as this would indicate. He says that at least three individuals have been found at various times on the shores of the British Isles (in Ireland, and in England at Plymouth and in Northumberland), and he further states that during the past year he has examined two specimens from the shores of Scotland, one of which was alive when cast up on the Firth of Forth, not many miles from Edinburgh. The latter specimen exceeds in size that which was stranded on the "Caronia," and Dr. Ritchie has had it placed on exhibition in the Royal Scottish Museum, a plaster cast having been made of the fresh specimen. This remarkable specimen was described by him at the British Association meeting in Edinburgh in September of 1921, and the description will be published in an early number of the *Scottish Naturalist*.

It is quite evident, however, that the records of this species are few and noteworthy, and that the specimen in the American Museum of Natural History ranks well among the captures in point of size.

ICHTHYOLOGY

ON DECEMBER 15, Dr. E. W. Gudger, associate in ichthyology, American Museum, gave an address on "Sharks and Shark Hunting" before the Biology Club of the College of the City of New York. Readers of NATURAL HISTORY will recall the pictures of sharks which Dr. Gudger supplied for the article "What Sharks Really Eat" in the May-June issue. Although in his address, which was well attended, Dr. Gudger spoke of several sharks, he laid special stress on the nurse shark, *Ginglymostoma cirratum*.

MAMMALOGY

THROUGH the generosity of Ringling Brothers, the circus proprietors, the American Museum of Natural History was fortunate in coming into possession, in April, 1921, of the body of little John Gorilla, or John Daniel as he was at first called. John is now on view in a case containing other anthropoid apes, on the third floor of the Museum.

John was extremely affectionate and intelligent, and to Miss Alyse Cunningham, of London, his former owner, who has given a very interest-

ing account of his life in the issue of the *Zoological Society Bulletin* for September, 1921, credit is due for having developed these traits to an unusual degree.

Originally John Gorilla came from the French Congo and was taken to England in July, 1918, when not quite three years old. He entered England in company with a lot of monkeys consigned to that government for experimental purposes. He was sold to a departmental store as a Christmas attraction. A nephew of Miss Cunningham bought him in December, 1918, and under the tuition of the latter his real education began. He was taught just as a child would be taught to be cleanly. His feet and hands were washed twice daily and his hair combed and brushed. He sat at the table with the family and gradually acquired really good table manners. He loved children and heartily enjoyed playing with them. Many were the evidences of his intelligence and appreciation of kindness shown him.

He died in Madison Square Garden Tower, during the last week of April, 1921. His death created much interest among scientists, who saw in it the opportunity to acquire more definite knowledge of gorillas through a study of the anatomy of little John. Aside from this aspect of the case, John Gorilla left behind him a group of friends who sincerely mourned the loss of an intelligent and affectionate pet.

THE department of mammalogy, American Museum, has recently installed fifty-four new steel storage cases of the "slidelite" type. In view of the congested condition in the storage space of the department, it has been necessary to place these cases along the walls of the main corridor on the fifth floor.

TRIBUTES to the personality and scientific attainments of Dr. Joel Asaph Allen, late honorary curator of the department of mammalogy, American Museum, have appeared from the pen of H. E. Anthony, his colleague in the department, in the issue of *Science* for October 28 and of *Nature* for December 8. The "In Memoriam" address, delivered by Dr. Frank E. Chapman, curator of the department of birds, before the thirty-ninth congress of the American Ornithologists' Union, will appear in the January issue of *The Auk*.

IN FRONT of the ground sloth and glyptodont group (see NATURAL HISTORY, September-October, 1921, pp. 557-9) are shown a great armadillo, *Priodontes gigas*, and a two-toed tree sloth, *Choloepus hoffmanni*, placed there for comparison with their extinct brethren—the glyptodonts and ground sloths. In looking at these degenerate representatives of a race of giants, one sympathizes with the Spanish naturalist who



JOHN GORILLA OR JOHN DANIEL

Few apes have excited more interest than this young gorilla, which was reared by Miss Alyse Cunningham of London and given almost human privileges. It was later acquired by Ringling Brothers, the circus proprietors, but lived only a short time in its changed environment. The ape, mounted in a realistic attitude, has been placed on exhibition at the American Museum

objected to placing the *Megatherium* (the greatest of the ground sloths) in the order Edentata, since all the living species of edentates could dance in the hollow of its carcass.

None the less, the tree sloth is an interesting animal and much has been written about him. Charles Waterton, in the Third Journey of his *Wanderings in South America*, speaking of the sloth, says:

"Those who have written on this singular animal, have remarked that he is in a perpetual state of pain, that he is proverbially slow in his movements, that he is a prisoner in space, and that as soon as he has consumed all the leaves of the tree upon which he had mounted, he rolls himself up in the form of a ball, and then falls to the ground. This is not the case."

It seems probable that in writing this, Waterton had in mind the following account of the sloth given in *A New Geographical Grammar* by William Guthrie, Esq., London, 1776:

"Among those peculiar to this country, the most remarkable is the sloth, or as it is called by way of derision, the Swift Peter. It bears a resemblance to an ordinary monkey in shape and size, but is of a most wretched appearance, with its bare hands and feet, and its skin all over corrugated. He stands in no need of either chain or hutch, never stirring unless compelled by hunger; and he is said to be several minutes in moving one of his legs, nor will blows make him mend his pace. When he moves, every effort is attended with such a plaintive, and at the same time, so disagreeable a cry, as at once produces pity and disgust. In this cry consists the whole defense of this wretched animal. For on the first hostile approach it is natural for him to be in motion, which is always accompanied by disgusting howlings, so that his pursuer flies much more speedily in his turn, to be beyond the reach of this horrid noise. When this animal finds no wild fruits on the ground, he looks out with a great deal of pains for a tree well loaded, which he ascends with a world of uneasiness, moving, and crying, and stopping by turns. At length, having mounted, he plucks off all the fruit, and throws it on the ground, to save himself such another troublesome journey; and rather than be fatigued with coming down the tree, he gathers himself in a bunch, and with a shriek drops to the ground."

Sydney Smith wrote, in reviewing Waterton's book:

"The eagle to the sky, the mole to the ground, the sloth to the tree; but what is most extraordinary, he lives not upon the branches but underneath them. He moves suspended, rests suspended, sleeps suspended and passes his whole life in suspense like a young clergyman distantly related to a bishop."

Mr. Councilman says:

"Your sloth is a beautiful specimen and brought to my mind one that I had seen eating the leaves of a Cecropia. I saw him ascend a branch and completely disappear in a small bunch of leaves.

When he moved I saw him again but when he stopped it was impossible to distinguish him from the leaves. It was like a conjuror's trick and I watched the appearance and disappearance for several minutes."

Evidently Mr. Councilman had seen the sloth in its native haunts where its hair is covered with a microscopic green alga, which, as noted, renders the sloth almost invisible, a most extraordinary case of concealing coloration.

MINERALOGY

RECENTLY the gem collection of the American Museum has received, through the gift of Mr. M. L. Morgenthau, a fine addition to its series of objects illustrating the antique use of gems. This takes the form of a necklace-shaped assemblage of aquamarines and other stones which constituted the trappings of a vizier of Morocco of the period of about 1750. It is made up of nine triple pendants in the form of medallions, the center of each of the twenty-seven medallions consisting of a rough-shaped aquamarine. In the case of the largest, middle medallion, the aquamarine is encircled by irregularly cut diamonds and sapphires arranged alternately; in the large medallions of the end pendants and the smaller medallions the surrounding gems are garnets. Below each triple pendant is suspended a crescent set with garnets. The pendants are richly set in gold and the spacing between them is filled in with elongated gold beads and six-sided, flat plates of carnelian, the latter engraved with the significant star and crescent of Islam. The reverse of the pendant medallions is richly enameled in intricate patterns and the pendants, beads, and carnelian plates, are strung on green silk spaced with groups of sequins.

This detailed description, however, gives no adequate idea of the rich and striking effect of barbarity produced by this ensemble. The stones are rough-shaped and polished after the manner of mediæval jewelry, the settings following the somewhat irregular outlines of the central stones. Moreover, all of the larger aquamarines used as central stones give evidence of having been pierced, evidently to be strung together as beads—an indication that they must have belonged to a much older and more primitive piece of jewelry.

It would be interesting to trace the former history of these old aquamarine beads, for rarely, if ever, is a gem once cut destroyed. It never wears out. If not buried with its owner, it must pass on to grace the person of his heir, or that of some less legitimate appropriator, and even when buried it may be dug up to dazzle the finder, kindle new envies, mayhap even to prompt crimes. Gold and silver objects are ultimately melted up and shaped into something else. A gem never loses its identity. The

emeralds which graced Cleopatra are probably in existence somewhere in the world today.

READERS of the *Arabian Nights* will recall the reference in "The Second Voyage of Sinbad the Sailor" to an inaccessible valley, over the floor of which were strewn diamonds of incalculable value, and to the ingenious device employed by inventive merchants of the East to obtain the gems. The story relates that they flung meat into the depth as a lure to hungry eagles, which, in snatching up the meat, bore to their eyries also the adhering diamonds, that were then collected without difficulty.

There are numerous variants of this story, in some of which Alexander the Great figures as the contriver of the ruse. The oldest extant version of the story is contained in the writings of Epiphanius, Bishop of Constantia, in Cyprus, about 315-403. The story made its way to China and Arabia, to Persia and India, where Marco Polo picked it up during his travels.

A later day and more prosaic example of the employment of fowls for the recovery of precious stones is told by Mr. J. R. Sutton in a recent issue of the *Transactions of the Royal Society of South Africa*. In the early days of Kimberley, he relates, the breeding of poultry was a profitable business, because the fowls, picking for a dinner among the débris scattered about the mine, were wont to swallow not a few small diamonds. Hence it was customary after slaughtering a fowl, carefully to examine its crop for the possible yield of gem material. On one occasion no less than twenty-three diamonds, which in the aggregate weighed five and a half carats, were recovered from the crop of a pigeon shot on the DeBeers depositing floors.

The existence of emerald mines in the Muzo region of the Republic of Colombia was first disclosed to the world through the accidental discovery of small and indifferent stones in the crops of some chickens that had been introduced into the country. The location of the mines from which these gems were derived was, however, not ascertained until several years later, owing to the fact that the expedition under Captain Diego Martinez, which had come upon the stones in the curious manner mentioned, met defeat at the hands of the Muzo Indians, as had the previous expedition under Captain Luis Lanchero, to whom the introduction of the fowls in question is attributed. When finally the white men gained ascendancy over the region, the location of the mine was discovered through a happy accident. It was on August 9, 1564, that one of the Spanish settlers, riding into the little town of Muzo, found that his horse was limping, and dismounted to examine its hoof. What was his surprise when, in place of a common stone as the offending cause, he took out of the animal's hoof an encrusted emerald! The excitement that this find

occasioned in the village may easily be imagined. At once a party was formed that, with the owner of the animal, retraced carefully every foot of the trail over which he had ridden and the painstaking search resulted in the discovery of the since famous mines.

In our Southwest the industrious ants bring to the surface the garnets that obstruct their excavating and thus it happens that these stones are relatively abundant about ant hills. In serving their own ends these insects are thus unconsciously assisting man.

Popular fancy, in other periods of history, has associated gems of value with certain animals. Elizabethan and Jacobean literature, for instance, contains not a few allusions to the presence of a precious stone in the head of the toad. Thus Lyly in his *Euphues* states that "The foule Toade hath a faire stone in his head" and then euphuistically continues: "the fine golde is found in filthy earth; the sweet kernell lyeth in the hard shell; vertue is harboured in the heart of him that most men esteeme misshapen." The lines from *As You Like It* are even more familiar:

"Sweet are the uses of adversitie

Which like the toad, ougly and venomous,
Wears yet a precious Jewell in his head."

Curious potencies are attributed to this fictitious gem. One writer states that "it is available against envenoming"; another adds that it is "of power to repulse poysons, and that it is a most sovereign medicine for a stone."

ORNITHOLOGY

THE thirty-ninth Congress of the American Ornithologists' Union was held at the Academy of Natural Sciences in Philadelphia, November 8-10, 1921. There was an exceptionally large attendance of fellows, members, and associates. The three days devoted to the presentation of scientific papers were fully occupied with interesting and valuable communications.

The following papers were presented by members of the American Museum's department of birds: "The Distribution of Bird-Life in Ecuador," "In Memoriam—Joel Asaph Allen," "Discontinuous Distribution as Illustrated by the Species of the Genus *Diglossa*," by Dr. Frank M. Chapman; "The Distribution of the House Wrens of the Genus *Troglodytes*," by Doctor Chapman and Mr. Ludlow Griscom; "The Andean Condor as a Coastal Bird," "The Status of Cory's Shearwater," "Distributional Notes on American Water Birds," by Dr. Robert Cushman Murphy; "The Classification of the Woodpeckers and Their Allies," "A New Family of Neotropical Birds, the Ramphocænidae," "A Suggestion as to the Origin of Diastataxy," by W. DeWitt Miller; "The Problem of Field Identification" and "Identifying the Ducks of the Eastern United States at Long Range," by

Ludlow Griscom; "Some Remarks on the Avifauna of Matto Grosso, Brazil," by Mrs. Elsie M. B. Reichenberger. Mr. John T. Nichols of the department of ichthyology, who also attended the Congress, contributed a paper on "Yellowleg Skeletons."

The Brewster Medal, which was awarded for the first time at this meeting, was given to Mr. Robert Ridgway, as the author of *The Birds of North and Middle America*, vol. 8. Mr. James P. Chapin, assistant curator of African birds in the American Museum, was elected a fellow of the American Ornithologists' Union. an honor restricted to a total of fifty individuals.

PALEONTOLOGY

THE mountains of Cuba and the forests of Württemberg seem very far apart today, but the American Museum has recently received proof that the Jurassic seas of probably 130,000,000 years ago, in these two distant localities, were united by surprisingly similar forms of life. The collection made by Barnum Brown in 1918 and 1919 from the Jurassic beds of Cuba in the Province of Pinar del Rio has revealed a succession of the ancient cephalopods known as ammonites remarkably similar to those of Swabia and Switzerland and the Rhone Valley. As worked out by Miss Marjorie O'Connell for a forthcoming Museum *Bulletin*, we find in the mountains of Cuba an ammonite shell which in all of its proportions and dimensions varies by less than a millimeter from a shell of the same species described by the German palaeontologist Opper in Württemberg in the year 1863. This is a sure demonstration of the continuity of the seas which swept the coast of Cuba and of Württemberg in Jurassic times and furnishes convincing evidence of the exceptional value of species of marine shells for the history of the two hemispheres. It is especially gratifying to have in the American Museum, from formations of our sister republic of Cuba, palaeontological specimens of such value that they shed light on related European fossils. The collections in the American Museum from the Jurassic of Cuba take the lead, and Barnum Brown, who is now in Asia, may feel repaid for the care which he took in assembling them.

PROF. E. C. CASE, of the department of historical geology and palaeontology of the University of Michigan and one of the research associates of the Carnegie Institution, has secured from the Triassic beds of Texas a very valuable collection, which he reports under date of December 12, 1921, as including "the finest stegoccephalian skull ever found perfect; three phytosaur skulls; my new *Desmatosuchus*; some very puzzling dinosaur material." Triassic deposits are as rare in North America as they are abundant in Germany; the beds of Texas are one of

the few localities in North America where the Triassic fauna, the most ancient of the Mesozoic, has been revealed. Scattered localities are represented in the American Museum collections: the Egypt Coal Field of North Carolina, which has yielded a fine collection of the crocodile-like phytosaurs, described many years ago by Dr. J. Howard McGregor, research associate in human anatomy in the American Museum; the Triassic beneath the Palisades, directly opposite the city of New York, where was found a single phytosaur; the Triassic in Pennsylvania, lying immediately above the coal measures; and one promising locality near Lander, Wyoming, which was explored by the late Samuel W. Williston of the University of Chicago.

THE ostrich dinosaur (*Struthiomimus altus*) was a slender, long-legged animal with a very long neck and small, birdlike head. It had no teeth at all, but probably a horny beak like an ostrich. A very fine skeleton, found by Mr. Barnum Brown in Alberta, has been on exhibition in the dinosaur hall of the American Museum since 1915, but it was left in the queer, distorted position that it had when found in the rock and it was not easy for anyone to get from it a clear idea of what the animal really looked like. Recently there has been placed on exhibit a new skeleton that is not so complete, as the neck and head are missing as well as a good part of the tail; but it has been mounted in a standing pose, with the missing parts, copied from the more perfect skeleton, sketched in on the panel. It is temporarily placed in the Age of Mammals hall, opposite the huge *Gorgosaurus* skeleton. The sketch restoration by Erwin Christman shows how the animal may have looked when alive. Exactly what the ostrich dinosaur did for a living is still something of a problem. In the picture a couple of these creatures in the background are feeding on a bunch of plantains; for the climate of Alberta in the Cretaceous period was semitropical and such fruits grew wild in profusion. What prosperous banana plantations and sugar cane fields could have been laid out on the Canadian plains in those days, cultivated with the help of the horned or duckbilled dinosaurs as draught animals! What a fence one would have had to build to keep out the fierce carnivorous dinosaurs, threatening to play havoc with one's stock! As for the ostrich dinosaur, he might have been trained as a messenger. Speed he would have had, certainly, and a fine equipment for carrying small bundles in his hands; but too much dependence could not have been placed upon his intelligence.

However, we must check ourselves in the all too common tendency to think of animals only in relation to man, forgetting that these creatures walked the earth millions of years before man's dominion was dreamed of.

Another theory as to the habits of the ostrich



A SKETCH BY ERWIN CHRISTMAN OF THE OSTRICH DINOSAUR IN ITS ENVIRONMENT OF CRETACEOUS TIME



Although ostrich-like in respect to its long limbs, elongated neck, small head, and toothless beak, this Cretaceous dinosaur must in reality have been unbird-like in appearance, for it was, of course, devoid of feathers, had a long lizard tail, and was provided with grasping fore limbs

dinosaur is that the long fingers of the fore-limbs were used to rake up from the river bottoms the shells and crustaceans on which he may have fed. It is at all events clear that he was not a predacious beast although related to the huge carnivorous dinosaurs, nor was he well adapted to feed upon vegetation as were the duck-billed, armored, or horned dinosaurs that were his contemporaries.

Beside the restored skeleton have been placed the fore and hind limbs of another specimen of the same kind of animal. These limbs come from a somewhat later formation, the Edmonton beds, in the same region, and like the other specimens were found by the Museum expedition to Alberta in charge of Associate

Curator Barnum Brown. Mr. Brown is at present in northern India, looking into the possibilities for securing collections there that may throw light on the ancestry of man.

A FINE mammoth skull with part of the skeleton has recently been purchased by the American Museum from Mr. E. C. Swabey. It was found near Rochester, Indiana, about six years ago and is a female, as indicated by the small, slender tusks. The mammoth skeleton mounted in the hall of the Age of Man is also from Indiana, and is a male, the tusks being at least twice as large in diameter. The two specimens very well represent the variety or subspecies of the true mammoth that inhabited the central and

northern parts of the United States during the late Pleistocene. It was called *Elephas jacksoni* by Mather ninety years ago, but in recent years has been usually referred to the true mammoth or *Elephas primigenius*. It is, however, a larger and more robust animal than the Siberian or Alaskan specimens and it is not at all certain that they are really the same species. Critical study of these fine skulls will perhaps enable us to settle the question. W. D. M.

A VALUABLE collection of fossil mammals was secured last summer by the American Museum expedition under Albert Thomson in the Snake Creek quarries in western Nebraska. This collection has arrived at the Museum and the specimens are now being prepared for study and exhibition. It includes a dozen or more fairly complete skulls, besides many parts of skulls and a multitude of fragmentary specimens. The Snake Creek quarries are our richest source of fossil mammals of Upper Miocene and Lower Pliocene age. The quarries are about twenty miles south of the famous Agate fossil quarry, and represent the animals of a later geological age. The fossils are much more fragmentary than those at Agate, complete skulls are scarce, and only one entire skeleton has been found (the *Pliohippus* skeleton on exhibition in the alcove portraying the evolution of the horse). But while the Agate quarries contain the remains of only three kinds of animals (aside from unimportant fragments) the Snake Creek quarries contain the remains of a very large variety. More than fifty different genera have been recorded from it, and every new collection adds to the number. The majority of these animals are still known only from jaws or parts of skulls; but Mr. Thomson's collection includes at least a dozen fairly complete skulls, and these will add largely to scientific knowledge. One of the skulls in the collection which has been prepared and studied may serve as an instance. In 1856 Doctor Leidy described a small fossil tooth by the name of *Leptarctus*, found at Bijou Hills, near the Missouri River. It was supposed that the animal to which the tooth had belonged was a relative of the raccoons and coatis. In 1892 Doctor Wortman found a lower jaw which he believed confirmed this relationship. Two lower jaws were also found in the Snake Creek quarries, and finally last summer Mr. Thomson secured a complete skull. This skull shows that the creature belonged to a peculiar group, about halfway between the raccoons and the badgers in its affinities. It was not an ancestor of the raccoons, as had been supposed, but an extinct group, and must be placed rather with the badgers in the family Mustelidae than with the raccoons in the family Procyonidae. No one could have known this from the study of the single upper tooth and the incomplete lower jaws that were previously known; but the skull settles the matter.

THE unexpected always happens in the pre-history of man. In "Bone Cave," at the Broken Hill Mine in northern Rhodesia has been discovered a skull of pre-human type which seems to be transitional between the most primitive member of the human family at present known to us, the erect ape-man (*Pithecanthropus erectus*) discovered in Java by Doctor Dubois in 1892, and the true Neanderthal man. Fortunately, the skull is quite complete and, while the jaw is missing, the collar bone, leg bone, and part of the hip bone were found and will enable us to arrive at some idea of the bodily form of this new Rhodesian man. Fortunately, also, the specimen was taken to the British Museum of Natural History in London, where it arrived November 7, 1921, and has fallen into the very able hands of Dr. Arthur Smith Woodward and of Prof. G. Elliot Smith, the most competent authorities among living students of human anatomy to pronounce upon its relationships. Dr. Elliot Smith writes, November 8, 1921, that it is an entirely new species, if not genus, of the human family, being far more primitive than the Neanderthal, and in many respects curiously suggestive of *Pithecanthropus*. The same authority states that there is also a fragment of the upper jaw of a second skull and that the whole find is extraordinarily interesting as it raises a host of fascinating problems. Dr. Robert Broom, of Douglas, South Africa, writes: "It is much like *Pithecanthropus* but fortunately nearly perfect. . . . The lower border of the nostril is still filled with matrix and the limits are not clearly shown. Won't it be grand when Doctor McGregor makes a restoration of this man!"

A finely illustrated account by Dr. Smith Woodward appears in the *London Illustrated News* of November 19, 1921.

THE fossil-bearing beds of the famous Tarija region of Bolivia, recently described by Marcellin Boule, professor at the Muséum National d'Histoire Naturelle, Paris, in his monograph, *Mammifères Fossiles de Tarija*, resemble those of our western Bad Lands so closely that it is hard to believe they are not of the same geologic origin. The city of Tarija lies in southern Bolivia near the Argentine frontier, at an altitude of 1770 meters. In his introduction Boule observes:

"The great distance from any port of embarkation, the material and financial obstacles attending transportation on mule back over uneven ground, of pieces that are both very heavy and very fragile, make the scientific riches of Tarija difficult of access to the museums of Europe. Therefore, we ought to be duly grateful to the Expedition of G. de Créqui-Montfort and E. Sénéchal de la Grange for having worked these fossil beds and for having succeeded first in acquiring and then in transporting to France, there to be presented to the Museum, the superb

collection which is the subject of this Memoir and which includes remains of several hundreds of mastodons, of a hundred horses or related animals, and of at least an equal number of llamas, without counting the edentates, rodents, and Carnivora."

In Pleistocene times Tarija was on one of the great animal migration routes traversing North and South America. It received from the former continent its mastodons, horses, peccaries, deer, bear, and Carnivora, which met from the southern continent the macrauchenias, toxodonts, and giant and lesser sloths, remains of which are preserved in the rich collections of the Muséum d'Histoire Naturelle in the Jardin des Plantes.

BELGIAN CONGO

The Zoölogy of the Belgian Congo is appearing in sections in the American Museum *Bulletin* and *Novitates*. It will probably be issued uniformly in twelve volumes on the completion of the series. The work on the different papers is making excellent progress, although on no group of animals are the reports as yet complete. If they were to be assembled at present, the first volume would contain miscellaneous papers; the second, monographic studies on vespids by Joseph Bequaert and on reptiles by Karl P. Schmidt; the third, a report on land mollusks by Pilsbry; the fourth, papers on invertebrates by various authors. A volume on ants, in two parts, by William Morton Wheeler and collaborators, will comprise possibly about 1100 pages and 40 plates and, like that on the wasps, will be a great contribution to our knowledge of Hymenoptera.

Twenty-eight papers have already appeared, as follows: introduction, four on mammalogy, six on ornithology, three on ichthyology, one on herpetology, six on entomology, and seven on general invertebrate zoölogy.

JOHN BURROUGHS

UNDER the auspices of the American Academy of Arts and Letters and of the National Institute of Arts and Letters a memorial meeting in honor of John Burroughs was held on November 19, in the auditorium of the Academy building, 15 West 81st Street, New York City.

Among those who through their presence paid affectionate tribute to the personality and greatness of the seer of Slabside were artists, men of letters, and scientists. The attendance at this gathering of the diplomatic representatives of Brazil, Chile, France, Mexico, and Spain was a convincing reminder that Burroughs' reputation as a naturalist and a man of letters is international.

Those who spoke—some of them from an intimate knowledge gained by long association with

Burroughs—were President Henry Fairfield Osborn, of the American Museum, John H. Finley, Hamlin Garland, and Bliss Perry.

Portraits of Burroughs, to the number of fifteen or twenty, painted by Orlando Rowland, Joseph Mannheim, and others had been hung on the walls of the auditorium, and on the floor itself had been placed sculptures of Burroughs by Pietro, Paolo, and others.

WOODS AND FORESTRY

IN A recent number of *American Forestry* Mr. Henry S. Graves pays a fine tribute to Dr. Charles Sprague Sargent, whose study of the forests of this country, undertaken in connection with the tenth census (1880), Mr. Graves characterizes as "the first action of importance" initiated by the Federal Government in the interest of forestry. The results of Doctor Sargent's study were of so monumental a character that an entire volume of the census was devoted to their presentation. This volume includes a catalogue of the forest trees of North America, exclusive of Mexico, with remarks upon their synonymy, biographical history, distribution, economic values, and uses; a section on the fuel value and the value as construction material of the wood of the principal timber trees of the country; and finally, a section, fully illustrated by maps, tracing state by state the forest resources of the United States in their economic aspects. Mr. Graves points out that in connection with this work for the tenth census Doctor Sargent was able, through funds generously supplied by Mr. Morris K. Jessup, to gather a noteworthy collection of specimens of the woods of the United States. These specimens were in the form of cylindrical sections of tree trunks with the bark attached and with a portion of each section cut in such a manner as to indicate the grain of the wood. Of this collection, which has long been an object of attraction in the American Museum, Mr. Graves says: "So far as I know there is no other collection of wood specimens equal to it anywhere in the world."

THE observant visitor at the American Museum who pauses before the New England spring group or the Florida group in the reptile hall on the second floor and marvels at the life-like appearance of the mounted animals is but paying tribute to the ingenuity no less than to the artistic sense of the Museum's preparation staff and the value of museum exhibits as a means of education. The seventy-five or more specimens of animal life in the New England group and the 150 in the Florida group (the largest yet attempted in the American Museum) have been endowed with a naturalness attainable only by the most delicate skill in fine modeling and color work applied to the original wax casts—for that is what they really are. The

following statement answers briefly the many inquiries that have come to the Museum regarding the technical processes used in preparing specimens for exhibit.

The usual method of casting from the plaster negative to the wax positive is used. When specimens are too soft, however, to have a mold made from them, they must be treated differently. Kerosene oil is put into a pan, and plaster mixed with water is poured into the oil; when this plaster is partly set, the soft specimen is put into it, and the lower half of the mold is allowed to set hard; the upper half is then cast; the oil gives buoyancy to the specimen and prevents the heavy plaster from sagging it. Very small and soft specimens are frequently modeled in wax by hand.

After the wax casts are made from the plaster mold, much skillful tooling and modeling are necessary. The wax must be of a certain flexibility when worked, and the tools kept heated at a proper temperature to insure success in portraying the delicate body lines, scales, etc.

The cast is then colored, a living specimen being used as a model. The eyes, made of glass, must be accurately painted on the inner surface and set in the wax at just the right angle; the eyelids also must be carefully modeled to give individual expression. This colored wax model has an appearance of life which is frequently unattainable in a mounted skin, for it possesses the advantage, not to be underestimated, of exhibiting the subdued translucency characteristic of many of the specimens when alive. When warmed, the finished cast can be easily posed on trees or elsewhere in any position.

Among those on the preparation staff of the Museum is an artist, Frederick H. Stoll, who possesses unusual accuracy in reproducing reptile and amphibian forms from life; to this, as well as to his careful observation and study of the living animal, is due his success in bringing to perfection the wax cast so that it appears lifelike enough to be mistaken for the real creature. In addition to the specimens in the New England spring group and the Florida group, another fine example of Mr. Stoll's workmanship is the alligator snapper (*Macrochelys temminckii*), recently placed on exhibition on the second floor of the American Museum—the first alligator snapper to be mounted here. Because of the huge size of the specimen and the costliness of wax, the cast was made in plaster. Plaster, however, is extremely opaque. To overcome this a thin coating of wax and turpentine was applied to the surface of the cast, very delicately so as not to destroy the reproduction of the texture as shown in the plaster. When paint is applied to a model treated in this way, a soft, fleshy appearance is imparted to the body and the translucent effect of horn to the carapace.

As the fleshy parts inside the mouth of the turtle were soft, a plaster cast would not have



Mr. Frederick H. Stoll, an artist of unusual ability and seriousness of purpose, connected with the American Museum, comes from Swiss ancestry—miniature painters, ivory carvers, and sculptors. He is known in the museum as an expert wax modeler and colorist with considerable breadth of artistic appreciation

been very accurate. Accordingly these had to be modeled in wax by hand. A mixture of wax and color of the consistency of thin cream was then sprayed on with an atomizer, giving a lifelike appearance. The peculiar fleshy protuberances above the eyes were also modeled in wax, as were the claws. Wires were placed inside the claws to strengthen them and to fasten the claws in place.

The methods described require modification according to the effect desired and the nature of the texture to be reproduced, and it is the skill and care with which each specimen is studied that insure the final successful result.

OTHER MUSEUMS

AN INTERESTING account of the second expedition made by Martin Gusinde to Tierra del Fuego appears in Volume II, No. 2, of the publications of the Museo de Ethnología y Antropología de Chile. The first expedition, made in 1919, was devoted primarily to a study of the Ona, one of the nomadic tribes of the region; the second trip to a companion study of the Yámana. In the four centuries that have elapsed since Magellan conducted his armada through the tortuous strait, walled with snow-clad mountains, that bears his name, this people, popularly thought of as cannibals but, accord-

ing to Señor Gusinde, showing no proclivities to justify their reputation as such, have so dwindled in number that they are approaching the verge of extinction.

In addition to securing valuable ethnological material for exhibition purposes, Señor Gusinde was able, through the rare confidence which the Indians reposed in him, to gather from their lips a treasured collection of myths. Most interesting of all, however, he was one of three initiates—the other two being Indians—to participate in the ceremonies connected with pubescence, which prior to that had not been celebrated for about nine years. He relates how he was seized, borne off to the place where the rites were to take place, and blindfolded, being freed of his encumbrance only when the feigned evil spirits entered to strike terror into the hearts of the neophytes. Two sponsors were then assigned to each neophyte to watch over their charge and instruct him in all the things that he should know. Severe physical ordeals followed, including fasting and the assumption of a squatting pose, to be maintained without moving or looking about. Deliberately the older people said laughter-provoking things, but the neophyte was debarred from joining in the merriment. They would at times put an insect upon him, taking good care that he did not brush it off. At night they would permit him about three hours of sleep, requiring, however, that he should preserve the position maintained during the day. Monotonous chants were sung day and night for the purpose of keeping malignant spirits at a distance. In the course of this ordeal Señor Gusinde was told many of the myths of this people: that of the creation of the world, the coming of the first men, and the instructions they gave to the Yámanas, their direct descendants—all of importance for ethnology.

The Museums Association, the object of which is the promotion of better and more systematic working of museums, held its thirty-second annual meeting in Paris, July 12-18, under the presidency of Sir Frederic G. Kenyon, director of the British Museum. One of the amphitheatres in the Musée National d'Histoire Naturelle was set apart for the gathering. Mr. L. Earle Rowe, a delegate of the American Association of Museums, spoke on the growth and development of art museums in America.

MR. L. B. COLEMAN, until recently chief preparator of the American Museum, became director, on October 1, 1921, of the American Museum of Safety. This museum is maintained by the Safety Institute of America, 141 East 29th Street, New York City, which was incorporated in 1911. Through exhibits this museum purposes to acquaint the public with devices for conserving human life, which in this age of

machinery is exposed to so many hazards. The position in the American Museum left vacant by Mr. Coleman's departure has been filled by Mr. Rubin R. Rector.

BIOGRAPHIC

DR. LOUIS DOLLO, of the Natural History Museum of Brussels, present leader of vertebrate palæontology in Europe, will soon celebrate his sixty-fourth birthday. He has issued in good health from the trying period of German occupation of Brussels and is continuing his lectures in the University there and his researches in the Museum, especially on new fossils from Orsmael, Belgium, which he is inclined to compare with the very ancient Torrejon mammals of New Mexico. Among his European fellow-workers, Doctor Dollo greatly admires the work of Othenio Abel, of Vienna and of Dr. Hans G. Stehlin, of Basle, Switzerland. He considers that vertebrate palæontology in Europe as a whole is in a very chaotic condition at present and that a new conspectus of our knowledge is very desirable—a *résumé* of recent discoveries, both in America and Europe. It appears that Pompečki, of Berlin, will describe the splendid Tendagaru Collections of sauropods of East Africa. Doctor Dollo is hopeful of constructing new galleries of palæontology in Brussels in his unique arrangement of geologic order. The Museum is enormously rich with sixty thousand specimens representing the cave fauna of Belgium alone. On another page we show a little diagram of Dollo's proposed arrangement when the Belgian Government provides the funds. The only obstacle is the cost of construction in Brussels, which, it is said, is ten times as great as it was.

NEW YORK AQUARIUM

THE attendance at the New York Aquarium during 1921 exceeded that of any year since the commencement of the war. The impressive total of 2,281,611 visitors during the first eleven months of the year—a total equivalent to more than a third of the population of Greater New York—measures the educational influence which this institution exercises in the metropolis. The new tanks to be installed in the space vacated by the old pumping plant will increase the exhibition space of the Aquarium by fully one fifth and will offer a new incentive to those who would view the life of the deep.

The Aquarium boat "Sea Horse," built by the Zoological Society for the use of the Aquarium, has rendered splendid service for two seasons, having brought to the Aquarium in brief, weekly trips, more than 5000 marine fishes of more than sixty different species without going more than twenty miles from the Aquarium. The possession of this first-class boat has made com-

PALAEOZOIC	GALLERY	
JURASSIC	GALLERY	
LOWER CRETACEOUS	GALLERY	
UPPER CRETACEOUS		
TERTIARY		
QUATERNARY		
		INVERTEBRATES

**PRESENT AND PROPOSED FLOOR PLAN OF MUSÉUM D'HISTOIRE NATURELLE,
BRUSSELS, BELGIUM**

The wing on the left is reserved for the palaeontological collections made in Belgium and other countries; the wing on the right will be devoted to the zoological collections

paratively easy the work of maintaining the exhibits of the Aquarium, which had previously been a heavy burden on the staff and employees.

In the collecting work of this well-boat, Mr. C. M. Breder, who was appointed aquarist on April 1, 1921, in place of the late W. I. De Nyse, and Mr. S. A. Callisen, who since June 15, 1920, has been serving as clerk, participated actively. Papers by Mr. Breder on the life history of the puffer, *Spheroides maculatus*, and on the hermaphroditism in the croaker, *Micropteron undulatus*, have been accepted for publication in *Zoologica*. In the *Bulletin* of the Zoological Society for November, 1920, Mr. Collisen published a popular account of the extensive pound net fishery of Lower New York Bay. He is now preparing an account of the rather extensive lobster fishery in the same neighborhood.

Miss Ida M. Mellen, secretary of the Aquarium, prepared two numbers of the *Zoological Society Bulletin* devoted exclusively to the care of small aquaria fishes. These two *Bulletins* excited popular interest to such an extent that they have been reissued as one of the Aquarium Nature Series under the title of *Fishes in the Home*. Miss Mellen has prepared for *Zoologica* an illustrated paper on pond life and for *Zoopathologica* a catalogue of the parasites of fishes exhibited in the Aquarium.

CONSERVATION

A SIGNAL victory for bird protection,—a movement in which, it is to be hoped, all the countries of the world may ultimately be leagued,—has been achieved in England through the placing on the statute books last July, of the Importation of Plumage (Prohibition) Act, which will come into operation in April, 1922. It forbids the importation of wild birds' feathers for millinery purposes, with two exceptions specified in the schedule—African ostrich and eiderduck. Facilities are, of course, allowed to approved persons for obtaining specimens for scientific research.

Under the Act an Advisory Committee has been appointed by the president of the Board of Trade, with power to recommend the addition to, or removal from, the existing schedule, of the name of any bird. Supporters of the Act have no cause to be anxious as to the future decisions of this Committee, for it is difficult to see how the special conditions that may have justified the exemption of the ostrich and the eider duck can be shown to apply to any other wild bird.

Thus has ended the long and bitter conflict against the feather trade centered in London—the largest market in the world. It is more than twenty years since the fight began. The power of the vested interests attacked, the congestion of Parliamentary work, and the indifference of an unstirred public opinion made the

task appear at first hopeless. But once the case for the birds was stated and understood, splendid support was given both in and outside Parliament. Throughout the campaign, money was most generously subscribed by men, women, and children living not only in the British Isles but all over the world. Workingmen would send contributions from their wages, and children, their Christmas money.

There are two names which will always be associated with the work—that of James Buckland, who started the movement and whose inspiration long outlived the short lease of life which left his task unfinished, and that of Harold Massingham, Founder of the Plumage Bill Group, whose untiring advocacy led to this year's victory. Those who have worked in England for this long overdue reform feel, however, that even now the battle is only half won and that although an important advance in the protection of bird life is foreshadowed by the imminent closing of the world's central market, yet no security can be reached until all the other markets are closed too, so that the dead body of a bird will have no market value. It is hoped, now that England and America are united in their resolve to suppress the slaughter of birds for millinery purposes, other countries may be induced to join in the movement, so that by concerted effort an end can be put to this misuse of one of the crowning glories of creation and save for future generations a vanishing heritage of usefulness, beauty, and joy.

ONE HUNDRED TWENTY THOUSAND women, members of the New York City Federation of Women's Clubs, are organizing in Greater New York, under the leadership of Mrs. Charles Cyrus Marshall for the purpose of arousing interest in the conservation of natural resources. That their influence in this direction may be more definitely felt, the Conservation Committee of the Federation, of which Mrs. Marshall is chairman, met with representatives of the various women's clubs at the American Museum on November 29, to outline plans, the chief feature of which is the celebration of the first week in April as Conservation Week.

The coöperation of the State Federation, with a membership of 300,000, has been secured for this celebration, so that the movement will be at least state-wide. As arrangements for Conservation Week are developed, it is probable that the Federations of other states will also join in its observance. Each day of the week will be dedicated to the study of a designated aspect of the conservation problem. To quote Mrs. Marshall, "Women will do much better work for conservation when they know more about it. Fortunately they realize this and are eager and willing to learn." That they may be accurately informed, lectures will be given during the week on such subjects as reforestation, the

national parks, the protection of animal and plant life, stream pollution, and the conservation of the water supply. One day of the week will be set aside that honor may be paid to great naturalists and conservationists such as Roosevelt. The Federation of Women's Clubs has demonstrated its power for good in numerous instances where a question of public welfare has arisen. Similarly on this occasion, the enlightenment of public opinion which will result from the observation of Conservation Week by thousands of American women should add great impetus to the conservation movement.

THE American Bison Society, founded in 1905 for the permanent preservation and increase of the American bison and the protection of North American big game, under the successive presidencies of William T. Hornaday, Franklin W. Hooper, Henry Fairfield Osborn, and Edmund Seymour, has been instrumental in restoring the bison to North America and in indirectly increasing their number from 1116 in 1908 to 9311 in 1920. Since 1919 the Society, under the vigorous presidency of Edmund Seymour, has taken up the preservation of the American antelope or pronghorn, which is still nearer the verge of extinction than was the bison at the time of its greatest depletion. One of the first steps was to seek protection for the few remaining bands of wild antelope that still existed in remote sections of the country, by cooperating with the government in creating an antelope preserve under federal protection. Early in the spring of 1921 the society purchased, under contract, ten young antelope, to be captured in Alberta, Canada, with the consent of the Dominion Government, for the purpose of stocking the Wichita Preserve in Oklahoma. The capture of these antelope (3 bucks and 7 does) was successfully carried out and shipment was made. They arrived in the preserve without a blemish, and are said to be an unusually perfect lot of specimens. This splendid work has been supported by contributions from outsiders like the Wild Life Protection Fund, the New York Zoological Society, the Audubon Society, and the Boone and Crockett Club and by liberal contributions from individuals interested in the preservation of North American big game, like George D. Pratt, John C. Phillips, A. Barton Hepburn, John D. Rockefeller, Jr., H. A. Edwards, John M. Phillips, William P. Wharton, Robert M. Thompson, Louis Weber, and many others.

ONE of the most flagrant and vicious cases of the needless destruction of wild animals is the reported recent shooting of a number of pronghorn antelopes in one of the few places where these once abundant and widely ranging animals are still to be found.

Along the boundary of eastern Oregon and northern Nevada there is a strip of territory, valueless for agricultural purposes, which has long been occupied by a band of antelopes. Efforts were being made to have this area set apart as a sanctuary and thus assure protection to these graceful animals. The proposed creation of such a refuge aroused, however, the antagonism of certain sheepmen who in late years have been making use of this region as a pasture for their herds. It is said that in order to defeat the project, the sheepmen threatened to exterminate all the antelopes of the region. The recent discovery of fourteen antelope carcasses on the Oregon side of the boundary line and the reported slaughter of twenty-seven antelopes a little farther north will, it is to be hoped, prompt the authorities to take stern measures to protect this jeopardized band.

IN THE November issue of the *Oölogist* is printed an extract from a letter by Harold H. Bailey, director of the Miami Zoological Park and Museum of Natural History. The letter is addressed to the American Consul at Nassau and contains an appeal for the more adequate protection of the flamingo colonies of the Bahamas. The government of the Islands imposes a heavy fine on any one molesting the birds but because of the dearth of wardens, offenders easily escape punishment. Neither the eggs nor the birds are spared and Mr. Bailey believes that if these conditions persist, the flamingos of the Bahamas will more than probably become extinct. An indispensable step in according protection is the appointment of a warden for each one of the four breeding colonies. It would be a neighborly act, and one in harmony with the spirit of international cooperation that is making itself manifest, if one or another of the societies in America that are interested in conservation offered its aid in establishing such a wardenship.

In 1904 Dr. Frank M. Chapman, of the American Museum, made a close study of the nesting habits of these birds. From a blind placed in a bush in the heart of the colony, he was able to secure a series of photographs that made possible a veracious reproduction, in the impressive habitat group on the third floor of the Museum, of the attitudes and the activities of these birds. With the threatened extinction of the Bahama colonies, this lifelike representation of a flamingo city is assuming importance as an historic record, a distinction already acquired by the habitat group illustrating the now extinct Klamath Lake bird colony. Klamath Lake, on the Oregon-California boundary line, dominated by the lofty peaks of Mount Shasta, was until recently one of the favorite haunts of water birds. On its tule or rush islets, nested in fancied security white pelicans, California and ring-billed gulls, Caspian terns, and Farallon cor-

morants. The drainage of this lake has resulted in the dispersal of these birds and today the habitat group in the Museum is an evidence of the interest and beauty of the Klamath Lake region before man attempted to pervert it to his uses. We say "attempted" for the soil has proved to be too alkaline to be suitable for agricultural purposes.

AWARDS

COLONEL ROOSEVELT, casting a retrospective glance over the adventurous trip recorded in *Through the Brazilian Wilderness*, said: "Such a trip as that we had taken tries men as if by fire. Cherrie had more than stood every test; and in him Kermit and I had come to recognize a friend with whom our friendship would never falter or grow less." Mr. George K. Cherrie, to whom this fine tribute was paid by his great fellow explorer, is the veteran of many an expedition to Latin America undertaken in the interests of the American Museum and has richly deserved election as Honorary Fellow in that institution—a distinction awarded him by the unanimous vote of the Executive Committee, at a meeting held on November 23, 1921. The Resolution conveying this award was worded as follows:

"RESOLVED, That the Trustees desire to record their warm appreciation of the exceptional services which George K. Cherrie has rendered to The American Museum of Natural History in particular and to the science of ornithology in general through extensive collecting expeditions in Latin America, which cover a period of more than thirty-four years. His rare skill and indefatigable energy as a field collector have greatly enriched the Museum's collections of birds and have revealed many species new to science, while his keen sense of justice, his splendid courage, his appreciation of the temperament and viewpoint of foreign people, and his high principles of living have made him a representative of American ideals of which the Museum and the whole country may be justly proud. In recognition of this enviable record and of Mr. Cherrie's years of devotion to the Museum, the Trustees take pleasure in hereby electing him an *Honorary Fellow*—the highest gift in their power to bestow."

THE SOCIÉTÉ NATIONALE D'ACCLIMATATION DE FRANCE, the leading zoological society of France, has awarded its Grande Médaille to the American Bison Society, and to the Rev. Sheldon Jackson, in memoriam.

The Société Nationale d'Acclimatation de France stands as high as the Zoological Society of New York and the Zoological Society of London, and devotes special attention to the acclimatization of species in places never before occupied by them.

The medal given the American Bison Society is of silver and was designed by Barre. On the

front is the intaglio of Isidore Geoffroy Saint-Hilaire, a celebrated French naturalist, the founder of the society, and upon the obverse is:

Société Nationale d'Acclimatation de France
The American Bison Society

1920

The medal awarded to the Rev. Sheldon Jackson, in memoriam, will be given to his two daughters, who live in Washington, and are his sole survivors. This medal is bestowed in recognition of Dr. Jackson's great service to Alaska in the introduction of the reindeer.

The medal awarded to the American Bison Society is bestowed in recognition of its preservation of the American bison on a continuing basis, and, accompanied by a handsomely engraved diploma, was transmitted to the society through the American ambassador, Hugh Campbell Wallace.

The society has been very successful in its work. Associated with the Biological Survey of the National Government and with the Zoological Society of New York, it has materially assisted in establishing some nine nucleus herds of American bison in various national parks in the United States. When the society started its operation, there were less than 1000 bison known to be in existence, a puny remnant of the millions that formerly roamed the western plains. Now there are in the United States, according to the last census, 3993 head of pure bred bison, and in Canada, 4080. In the Government herds there are 1032; 184 calves were born in 1920. The society, therefore, has accomplished the principal objects of its formation.

The society at the present time is taking up the preservation of the antelope, which is in danger of extinction. This animal is one of the most interesting. It is a purely big game animal and can subsist in the most arid portions of the United States.

The objects of the American Bison Society are the preservation and increase of the American bison and the protection of North American big game.

The officers are:

Honorary President, Theodore Roosevelt, in memoriam.

Honorary Vice President, Prof. Henry Fairfield Osborn.

President, Edmund Seymour.

Vice President, Dr. William T. Hornaday.

" " Carl K. MacFadden.

Counsel, Leonard D. Baldwin.

Treasurer, Clark Williams.

Secretary, M. S. Garretson.

PROF. HENRY FAIRFIELD OSBORN has recently been elected a Corresponding Member of the Société Géologique de Belgique, which was founded in 1874.

THE following extract from the Record of the Royal Society is sent by its secretary:

"In accordance with a resolution of the Council, a silver medal is awarded biennially in recognition of work of acknowledged distinction (especially in Biology) in the field in which Charles Darwin himself laboured. The medal is accompanied by a grant of £100. The first medal was awarded to Alfred Russel Wallace in 1890. The award may be made either to a British subject or a foreigner, without distinction of sex."

Awards of the Darwin Medal by the Royal Society have been made every second year since the foundation as follows:

- 1890 Alfred Russel Wallace
- 1892 Sir Joseph Dalton Hooker
- 1894 Thomas Henry Huxley
- 1896 Giovanni Battista Grassi
- 1898 Karl Pearson
- 1900 Ernst Haeckel
- 1902 Francis Galton
- 1904 William Bateson
- 1906 Hugo de Vries
- 1908 August Weismann
- 1910 Roland Trimen
- 1912 Francis Darwin
- 1914 Edward Bagnall Poulton
- 1916 Yves Delage
- 1918 Henry Fairfield Osborn
- 1920 Rowland Harry Biffen

The award of this medal to Rowland Harry Biffen, the last recipient, was made in recognition of his researches in the application of scientific principles to the breeding of plants.

SINCE the last issue of NATURAL HISTORY the following persons have been elected members of the American Museum:

Patron: MR. OSWALD UHL.

Honorary Fellow: MR. GEORGE K. CHERRIE.

Life Members: MESDAMES ROBERT WOODS BLISS, COLUMBUS O'D. ISELIN, HENRY R. REA; ROBERT S. RUSSELL; the MISSES ADELIA A. DWIGHT, EVELYN PRESTON; MESSRS. PIERRE C. CARTIER, CHARLES M. CHAPIN, CHARLES CHENEY, S. WILBUR CORMAN, GEORGE L. EATON, EMANUEL GERLI, OTTO R. KOEHL, JOSEPH PARSONS, CURT G. PFEIFFER, R. STUYVESANT PIERREPONT, JOHN T. PRATT, STEVENSON SCOTT, and ARTHUR S. VERNAY.

Sustaining Members: MESDAMES OTTO H. KAHN and WM. R. PETERS; MISS M. I. HENDERSON; and MR. M. TAYLOR PYNE.

Annual Members: MESDAMES JOHN W. ALEXANDER, ROSECRANS BALDWIN, J. A. BARNARD,

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"NATURAL HISTORY"

1922

NATURAL HISTORY, having attained its majority, stands at the threshold of its twenty-second year, grateful to the Museum members who have supported it and to the nature lovers who, without financial recompense, have filled its 7375 pages with records of their travels and observations in all parts of the world. NATURAL HISTORY will continue to invite nature lovers to tell their stories through its pages; it will describe what the American Museum and sister institutions are doing in every continent and among the celestial as well as the terrestrial spheres.

President Henry Fairfield Osborn opens the

present number of *Natural History* with a description of the important discovery of Pliocene Man in England, and for the issues of the new year will write several distinctive articles devoted to the ever-absorbing subject, the prehistory of man. These articles will be entitled: "The Birth of Sculpture in Southern France"; "Our Ancestors Arrive in Scandinavia"; "Brittany Four Thousand Years Ago."

Another feature of the new year will be a series of articles upon the history of the several departments of the American Museum. The accomplishments of the present can best be visualized through the contrasting condi-

tions of fifty years ago. The keen vision of those who planned the institution, the attentive study of the Museum's growing needs by those who in succeeding years assumed the responsibility of its direction, the steady advance from modest beginnings to the present magnitude, and the assurance of even greater expansion and increased usefulness in the future, constitute a story of achievement and bright prospects that is as inspiring as it is interesting.

In several remote corners of the earth expeditions of the American Museum are at work, solving zoölogical and anthropological problems. Other expeditions of this institution have successfully completed their work and are in a position to report upon their accomplishments. *NATURAL HISTORY*, as the organ of the American Museum, will tell of the progress of such field work. It will, through the contributions of Mr. Roy Chapman Andrews, keep its readers informed of the search for the earliest records of man in Asia. Through Mr. Carl Akeley, one of the keenest observers of jungle life, who is at present studying the gorilla in its native haunts, readers of the magazine will receive first-hand information regarding the home life of these little-known anthropoid apes. Dr. William K. Gregory, curator of the department of comparative anatomy, has but recently returned from a trip, rich in results, undertaken to remote Australia, where Mr. Raven, representing the Museum, is still engaged in field work. Doctor Gregory's experiences were full of varied interest and give promise of an article as entertaining as it is certain to be informing. The scientific accomplishments of Mr. Sullivan have been commented upon from time to time in the Notes of *NATURAL HISTORY*. Some weeks ago Mr. Sullivan returned from the Hawaiian Islands and is therefore able to report in person regarding the racial survey of the native population in which he has been engaged. Mr. Rollo H. Beck, whose collecting among the sun-bathed islands of the South Pacific has yielded the Museum many specimens of scientific interest, will continue to write spirited narratives of his adventures.

Conservation of the wild life of the world—that trust imposed by past ages upon the present and which the present has so flagrantly neglected—will receive in the pages of *NATURAL HISTORY* the emphasis that is demanded in view of the tragic inroads that continue to be made into the dwindling remnants of the world's once abundant fauna and flora.

Many are the contributions planned for publication in *NATURAL HISTORY* in addition to those outlined above dealing with the special undertakings of the Museum. Dr. David Starr Jordan, who has made so close a study of Japan and the Japanese, will write about his visit to a village of the Ainu, the indigenous race, now greatly depleted in numbers, that formerly occupied a large part of the archipelago. An article on the

"Stone Age Pottery of Japan" by H. Matsumoto, the distinguished Japanese palæontologist, will throw additional light on the history of early man. Dr. Ulric Dahlgren, director of the Harpswell Laboratory, will give an account of the luminiferous animals that inhabit the seas. The distinctive fauna of more than one of the tiny islands of the Madeira group will be discussed by Prof. T. D. A. Cockerell, of the University of Colorado. Dr. Edward W. Berry, professor of palæontology at Johns Hopkins University, whose article on "The Journey from La Paz to the Yungas" will be recalled with pleasure by readers of the September-October issue, has in train for publication an article on "Bolivia's Least-Known Mountain Range," which is written in the same delightful vein as his earlier paper. Mr. William J. La Varre will give a vivid account of his sojourn among the copper-skinned Caboklas of the Rio Negro, one of the confluent of the Amazon.

The National Geographic Association is engaged in the further excavation of Pueblo Bonito, the aboriginal ruin in northwestern New Mexico. Dr. Clark Wissler, curator of anthropology in the American Museum, in an article entitled "The Hyde Expedition and Pueblo Bonito" presents an account of the earlier archaeological results attained through the work initiated by Messrs. B. Talbot Hyde and Frederic E. Hyde, Jr. Associate Curator P. E. Goddard, of the department of anthropology, during his recent visit to North Dakota, witnessed the ceremonies connected with the completion by the Arikara Indians of one of their characteristic earth lodges. An account of these ceremonies will appear in an early issue. Mr. Charles W. Mead, assistant curator of Peruvian archaeology, will present some facts regarding tapioca, a familiar food of unfamiliar origin. An account of a four-hundred-mile trip by horseback along the boundary line between Utah and Arizona, taken in the company of Mr. Charles L. Bernheimer, will be contributed by Mr. Earl H. Morris, in charge of the Museum's excavation of the Aztec Ruin in New Mexico. Dr. Robert H. Lowie, until recently of the anthropological department of the American Museum and now associate professor of anthropology in the University of California, will contribute two papers, the one entitled "A Cultural Parallel Between the Lapps and the North American Indians" and the other "A Women's Ceremony Among the Hopi Indians."

"Nature Study with a Microscope" will be considered by Mr. Phillip O. Gravelle. "Some Little Known Songs of Common Birds," by Mr. F. H. Allen, will attract attention to a subject deserving closer study. "Labrador, Its Present and Its Future" will be discussed by Mr. Wynant D. Hubbard. Some of the rabbits of our western states will receive consideration in an article to be contributed by Mr. H. E. Anthony,

associate curator of mammals of the Western Hemisphere. The history of "The Public Museum of Staten Island" will be recounted by its director, Mr. Charles W. Leng, research associate of Coleoptera in the American Museum. Agricultural museums will be discussed by Director F. A. Lucas in an article accompanying illustrations, supplied by Mr. F. Lamson-Scribner, of certain museums of this character. Additional articles are promised by Messrs. Rockwell and Blickensderfer, whose joint contribution on the saw-whet owl forms so striking a feature of the current issue. Mr. W. De W. Miller, associate curator of birds, will communicate his observations on the food of the winter sparrow. In "A Pilgrimage to the Home of Fabre," Dr. L. O. Howard, chief of the United States Bureau of Entomology, will record his impressions of a visit to the site made famous by the studies of the great French entomologist. Mr. William Savin, who wrote a defense of the spider for the July-August issue of *NATURAL HISTORY*, has in train an article on the leaf-cutting bee, an insect that well repays study, and a further article on certain wasps that prey on spiders. Mr. W. H. Sheak, well known for his studies of the higher apes, will contribute a paper on this subject.

Dr. Edmund O. Hovey, curator of geology and invertebrate palaeontology, has in course of preparation an article on the Hawaiian Volcano, Haleakala, based on a personal visit to this natural wonder. Dr. Hovey will also present a review of Mr. Herbert P. Whitlock's "List of New Crystal Forms." Dr. Chester A. Reeds, associate curator of invertebrate palaeontology, will contribute an article that cannot fail to interest those who live in New York or its vicinity. This article will be devoted to an account of the geology of Manhattan Island and its environment and will inform the reader of things that he has seen over and over again but whose real significance he may have failed to appreciate. Bizarre happenings in the world of fishes, as interesting in their way as the "Rains of Fishes" described in the present issue, will be chronicled by Dr. E. W. Gudger. To the courtesy of Monsieur V. Forbin, *NATURAL HISTORY* is indebted for several interesting series of photographs, with accompanying captions, that will make their appearance in the course of 1922. Articles having to do with the general subject of nature study and the child are promised by Mrs. John I. Northrop, Miss Ellen Eddy Shaw, and Thornton W. Burgess.

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